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GIFT OF
Charles H. Raymond

THE MOTOR TRUCK AS AN AID TO BUSINESS PROFITS

By S. V. NORTON

A. W. SHAW COMPANY
CHICAGO NEW YORK
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Doing more work with fewer men in addition to its speed, power, adaptability, dependability, and greater effective range, are prime qualities of the motor truck. Here is a most striking demonstration of them. The platform is built especially for icing refrigerator cars and is raised or lowered by power from the engine.

HOW TO GET THE MOST VALUE OUT OF THIS BOOK

IN this book you will find page after page of helpful information about the operation and maintenance of motor trucks arranged in an easily readable form. The complete index literally places every fact in the book at your finger tips, and each of the 335 illustrations gives you the vital points at a glance, making it unnecessary "to wade through a lot of reading matter" to find the information you want.

Every plan and every suggestion in this book has behind it not only actual try-outs, but also successful performance under everyday business conditions. The book does not contain the ideas of any one authority or any ten. Rather is it a collection of tested plans used by hundreds of truck owners throughout the country, some of whom are authorities on motor truck economies, and others successful business men who have learned how to use motor trucks to increase their business profits.

In the broad spirit of modern business progress these men have given freely of their knowledge and experience to the author. Mr. Norton has been closely associated with the motor truck industry from its inception. As manager of the Truck Tire Sales Department of the B. F. Goodrich Rubber Company of Akron, Ohio, he has had many opportunities to study, at close range, the various problems of motor truck owners. His experience and intimate knowledge of motor trucks and their application to present-day business problems thoroughly qualifies him to discuss the subject from every angle.

The information is here. It remains only for you to apply the suggestions and tested plans to your own individual business problems. Two objections will probably flash in your mind as you open the book for the first time: one will be, "My business is different"; the other, "My business is too small"—but is it? It's important that we know whether there is any logic in either of these statements.

Let's take the first one, "My business is different." It is not difficult to show that this statement has no foundation in fact

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which is worthy of consideration. Fundamentally, the principles underlying success in one, a dozen, or all businesses, are the same, and one set of rules governs the large as well as the small just the same as the simple rules of addition, subtraction, division and multiplication form the basis of the most advanced mathematics. The individual marks of this or that particular business, which identifies one man as a peanut vender, another as a grocer, and a third as a steel magnate, are but the "clothes" which those particular businesses wear. They may vary from each other as widely as the attire of an Icelander varies from that of a Mexican, but beneath these "clothes" all the naked fundamental principles of business success apply to, and are used in each business alike, just as the principles of anatomy are the same in all races, regardless of dress or nationality.

With all business governed by the same fundamentals, it is reasonable to assume that any plan which succeeded in one business may be successfully transplanted into another. True, it may need adaptation, as would the salesmanship of the grocer need refinement if he becomes a steel magnate, but the basic idea behind the plan need not necessarily be changed in the least.

The objection that one's business is "too small" is also unsound nine times out of ten. As a matter of fact, much of the most valuable material in this book is based on the experience of business men who operate but one motor truck, but who are always numbered among the unusually successful ones. The very biggest of our concerns started small and most of the fundamental right and wrong ways, which they have searched out and are applying today, were also the right and wrong ways when they were small. If it is fundamentally right to handle deliveries a certain way, it is right to handle them that way regardless of the size of the business. Of course there may be exceptions, perhaps certain methods are only useful to large concerns; but in almost every instance, fundamental right and wrong ways in business are right and wrong ways in both the large and small organizations.

So do not allow these two excuses to interfere with your getting the greatest value out of this book. As you read it, bear in mind that merely "reading the book" for a general knowledge of the operation of motor trucks will be of no avail unless specific application, of those plans best adapted to your requirements, is made to your business.

A good way to begin would be to first get a general survey or outline of the book by thumbing over the index and table of contents. Many ideas will come to you as you do this. Make a careful note of each. Then start reading the book closely with these ideas in mind.

Select some plan—preferably a simple one at the start—that seems best adapted to your own particular needs, make what changes you think necessary, and then apply it to your business. Treat this simple plan the same as you would an expensive equipment you might be installing in your office or factory, and be certain that the "installation" is properly made. Explain to your employees, especially your drivers and helpers, just what you expect to accomplish and show them why it would be to their advantage to work hand in hand with you. Then watch the results.

The chances are that the results will be significant from the start. But whether they are or not, do not stop here. If one plan fails, try another, always bearing in mind that some plans may be applied without change while others must be altered here and there to meet special conditions.

As one plan is perfected, apply another and still another. Results are bound to come and you will not have progressed very far before you will be surprised at the savings in time, money, and increased business with which a small amount of perseverance in this direction will be rewarded.

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Denby Motor Truck Company, Detroit, Mich.
Detroit Taxicab & Transfer Company, Detroit, Mich.
Dodge Bros., Detroit, Mich.
Duplex Truck Co., Lansing, Mich.
Edison Storage Battery Company, Orange, N. J.
Elwell-Parker Electric Co., Cleveland, Ohio.
Federal Motor Truck Co., Detroit, Mich.
Fifth Avenue Coach Co., New York City.
Firestone Tire & Rubber Co., Akron, Ohio.
Ford Chain Block Company, Philadelphia, Pa.
Ford Motor Car Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Fruehauf Trailer Co., Detroit, Mich.
Galion Iron Works & Mfg. Co., Galion, Ohio.
Garford Motor Truck Co., Lima, Ohio.
General Motors Truck Co., Pontiac, Mich.
General Vehicle Company, Inc., Long Island City, N. Y.
Gimbel Bros., Philadelphia, Pa.
Gramm-Bernstein Motor Truck Co., Lima, Ohio.
Gulf Refining Co., Pittsburgh, Pa.
Haiss Mfg. Co., New York City.

Harvey Motor Truck Company, Chicago, Ill.
Wm. Hesse & Sons Company, Leavenworth, Kas.
Hippodrome Motor Company, Nashville, Tenn.
Hurburt Motor Truck Co., New York City.
International Harvester Corp., Chicago, Ill.
International Motors Co., New York City.
Jeffery Mfg. Company, Columbus, Ohio.
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The Lowerator Co., New York City.
Manhattan Storage & Warehouse Co., New York City.
Marshall Field & Co., Chicago, Ill.
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Mercury Mfg. Co., Chicago, Ill.
Meyers Machine Co., Sheboygan, Mich.
Miller North Broad Storage Co., Philadelphia, Pa.
Moreland Motor Truck Co., Los Angeles, Calif.
Nash Motors Company, Kenosha, Wis.
Old Reliable Motor Truck Company, Chicago, Ill.
O'Sullivan Rubber Heel Co., New York City.
Otis Elevator Co., Boston, Mass.
Packard Motor Car Company, Detroit, Mich.
Peerless Motor Car Company, Cleveland, Ohio.
Perfection Spring Co., Cleveland, Ohio.
Pierce-Arrow Motor Car Co., Buffalo, N. Y.
Pierce Governor Company, Anderson, Ind.
Jacob Press Sons, Chicago, Ill.
Republic Motor Truck Co., Alma, Mich.
Sears-Roebuck & Co., Chicago, Ill.
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Service Motor Truck Co., Wabash, Ind.
Service Recorder Company, Cleveland, Ohio.
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PART I

FITTING THE MOTOR TRUCK INTO YOUR BUSINESS

CHAPTER I

THE FIELD OF THE MOTOR TRUCK IN MODERN BUSINESS

NOT long ago as I walked to my office, my dog, prancing at my side, dropped a bone he was carrying, to bark at two foreigners trudging along the road. One was an old woman, quaintly dressed, carrying a pack on her back. The other, apparently her husband, was an organ-grinder with a monkey whose supple hands held out his tin cup for pennies. They moved to one side to let the grocery boy, chirruping to his horse, rattle past in his cart. A moment later the delivery cart in turn had to give way to a huge motor truck, laden with produce from the country, which bore down on it with a warning snort.

There, in the space of five minutes, had passed the evolution of centuries of the carrier in trade, from that which existed as far back as history is known, to the latest device created by man. Just when and where the four-legged animal came to walk on its hind legs and use its forelegs for carrying instead of its mouth, is not known. Moreover the gaps between the successive stages of this evolution have been very unequal in the twenty thousand or more years in the history of man himself. But the explorations of archeologists have given us clews as to when man first realized he needn't always stagger under the burden of whatever he wished to move.

The Evolution of Trade Carriers. The idea of a boat as a carrier came early in history. The very earliest known human beings fastened logs together and guided them down stream, or even scooped out one side of a fallen tree and made a rough canoe in which they carried their belongings. If they went by land, however, their method for centuries was to shoulder their loads pickaback. If two men were together they learned that the burden could be carried more easily if it were suspended from

a branch whose ends were supported on their shoulders. Thus the lever principle was used in many forms of carrying devices.

The Introduction of Metal Implements. Civilization lagged cumbrously, however, until man accidentally learned to melt copper out of the rocks against which he built his fire, and shape it into tools. For ages he had used stone hammers, clubs, and clumsy wooden knives to kill and prepare the animals he sought for food. But now he shaped a hoe to scratch the ground where his wife had dropped seeds of wild wheat and barley. In time he tamed the wild ox, and by means of a crude harness of strips of hide and sticks, he made the beast drag his hoe and thus gave us the first plow. In order not to lose the crop he had planted and learned to cultivate, he stopped wandering about long enough to make a settlement, near the banks of the river whence he had gone for water. Part of his crop he traded for hides from the shepherds driving their flocks about upon the hillsides. In those days men traded articles of food, shelter, or clothing for other wares which satisfied their needs. Business consisted of the actual exchange of the commodities themselves. When, however, pieces of metal and glass were wrought into beads, those who had food or clothing they could spare eagerly exchanged them for the new and attractive ornaments. Here, then, was the first money used in barter.

But when man learned by mixing tin and copper to make bronze, and from this to fashion tools with hard sharp edges, he soon made many convenient articles for domestic use, as well as weapons for warfare. Thus, in due time, perhaps as early as 3000 B. C., he learned to make the wheel which served as a burden-bearing device. It was but a short step, then, to the two-wheeled carts and chariots to which the merchants and warriors of ancient Babylon harnessed their oxen or donkeys.

The Horse Supplants the Ox. A thousand years later, or perhaps more, the mountaineers came down into Babylon leading a strange animal which the Babylonians had never seen. This beast proved so amenable to training, so strong and so fleet, that he began to supplant the slower and more cumbersome ox as a beast of burden. Thus the horse first appeared in a civilized community to play the important part he has maintained ever since in the commerce of the world. From that time to this, he has been regarded as the standard by which other units of transportation are judged.

And Finally the Horseless Vehicle. With the advance of civilization and the discovery of such forces as steam and electricity, remote communities became connected with each other by means of steamships and railways, so that trade and commerce grew to tremendous proportions. And with population rapidly increasing, men became specialists in the production of certain commodities by reason of their special abilities or the peculiar natural resources of the communities in which they lived. When two or more of these specialists produced the same merchandise, competition arose between them, and they frequently endeavored to sell their wares to the same buyers.

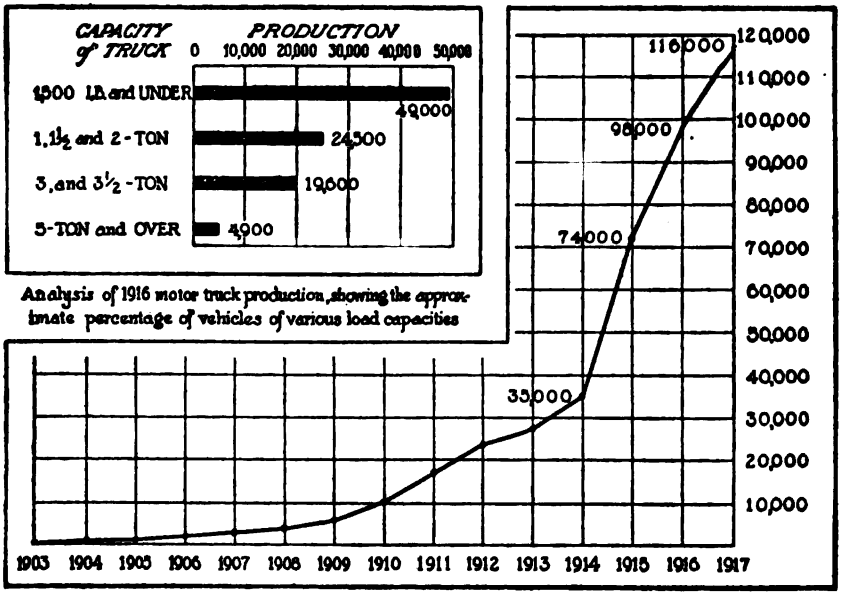


FIGURE 1: This chart shows the growth of production in the motor truck industry for the first fourteen years of its existence. Notice how insignificant it was during the first seven years, and then note the tremendous strides taken since 1913.

And, as competition increased, men found it necessary to avail themselves of every means of economy and efficiency in the manufacture, sale, and delivery of their goods. For years the horse and wagon supplemented the steamship and railway, but with the advent of the gasoline engine, the horseless wagon made its appearance and has steadily increased in favor for commercial haulage because it has proved to be stronger, faster and more economical than the horse and wagon.

Transportation by motor truck lies entirely within the twentieth century. While the railroads have been building since the fifties and have taken over half a century to acquire their present proportions, the first motor truck was built as late as 1900. Before the close of the year 1918, there will probably be over 400,000 motor trucks in service in the United States. In less than a score of years, the child has become a giant.

The Future of the Motor Truck. But the giant of today will be considered a dwarf in comparison with the giant ten years from today. If the growing output of motor trucks in the past decade is any indication of what may develop in the future, we may expect to see in years soon to come a system of transportation which will number its units by millions. According to the latest estimate of the Bureau of Animal Industry in Washington, there are now in the United States between twenty and twenty-five million horses and mules, most of which are engaged in hauling merchandise or in other commercial work which could be done more efficiently by motor trucks. There is almost no class of haulage to which the motor truck, with or without the aid of auxiliary devices, cannot be advantageously adapted. We might regard this enormous number of horses and mules, approximately one for every five inhabitants of the country, as a bank upon which the business of transportation is constantly making larger and larger drafts for conversion into investments yielding far more profitable returns.

And there seems to be no limit to the investment field in the realm of motor transportation, because from whatever aspect it is compared with the horse and wagon, the motor truck will generally be found to do more and better work for less money. In this connection, it may be interesting to cite here six of the conspicuous advantages of motor haulage.

(1) *Speed.* This is one of the most notable of its advantages. We are all familiar with the motor wagons which whisk away our newspapers from the buildings in which they are printed to the news stands not only in the crowded down-town districts, but also to the dealers in the suburbs. Produce dealers who deliver their fruits and vegetables to market by motor truck before they have wilted secure not only more business but larger profits. Similarly road contractors are not only able to haul stone and cement more cheaply by trucks, but because they can perform the work faster they may secure contracts with definite

FIGURE 2: From the slow plodding ox and the rickety ox cart to the modern motor truck is a jump of centuries, but they were as much of an improvement over previous forms of carriers as the motor truck of today is over the horse and wagon.

FIGURE 3: The value of speed in the motor truck is well exemplified by the newspaper truck, which must rush the latest edition to trains, boats, newsdealers and other distributing points ahead of competitors.

FIGURE 4: Power! The steel frame weighed 20,185 pounds. A 3½-ton capacity truck carried it under perfect control to the top of Mount Wilson over nine miles of treacherous mountain roads without a serious hitch.

FIGURE 5: This truck, in a forest in northern Maine, is about to descend a hill so steep that it is necessary to hold it back by means of a cable and pulleys. The man controls the speed of the descent by means of a brake lever.

time limits, which competitors using horses could not guarantee to fulfil within the allotted time (Figure 3).

(2) *Increased Power.* This is another conspicuous advantage of the motor truck over the horse-drawn vehicle. When the famous Carnegie Solar Observatory was being built in California, a 3½-ton truck carried a steel frame weighing 20,185 pounds to the summit of Mount Wilson, a peak 14,250 feet high, winding slowly up nine miles of treacherous mountain road, sometimes encountering grades of nearly 20% (Figure 4). The engineer who accomplished this remarkable feat told me it would have been impossible to have done this with horses or mules. In the case of the truck the driver had all the power he needed and more under perfect control in the engine itself, while the horses or mule teams would have had to spread out over a long distance, and it would have been difficult to drive them so as to get them all pulling together, to say nothing of the impossibility of applying the driving or pulling power effectively in turning the sharp curves of the mountain trail.

Another striking example of economical hauling due to the increased power of the truck is that of a Detroit contractor, who, with one tractor-truck, hauls regularly on a daily schedule over a distance of ten or twelve miles twenty-four tons of crushed stone in two enormous trailers. This train, which is equipped with twenty-six rubber tires, hauls as much material as the contractor formerly moved with fourteen mules, and does it between two and three times as fast. In New York City a five-ton dump truck established a record when it hauled 578 tons of crushed stone in seven hours, the distance of the round trip being a quarter mile. One of the most picturesque examples of the intelligent application of the power of motor trucks is that of the Great Northern Paper Company in northern Maine, where 200 mules were replaced by nine five-ton trucks, at the same time saving $200,000 for the company. Their account of what trucks have been able to accomplish for them in the wilderness is marvelously interesting (Figure 5).

(3) *Adaptability to Difficult Work.* Another distinct advantage possessed by the motor truck over its horse-drawn competitor is its adaptability to difficult work. In Cleveland a five-ton dump truck was used by a building contractor in a novel way that could not be employed if he were dependent upon horses. This truck, hauling concrete mixture in liquid form, was driven

up a steep incline to the second story of a building under construction. With no delay whatever, the truck dumped its contents at this level into a chute which delivered the mixture into the forms set up for the columns of the building. In describing this method the contractor said, "It would have required a team of ten mules to haul the same load up this incline, and such a train of animals could neither have been handled safely nor conveniently on the narrow incline and in the limited space at the top." (Figure 6.)

In Dallas, Texas, a 3½-ton truck was used to move a small house, no turnstile being required. By this method it was not necessary to damage the streets by sticking an iron pin in the ground and using it to pull against. The truck, which was at once powerful enough to haul the house and move it comfortably around corners, delivered its cargo to the newly selected site for the building the same day it had left its previous location.

Another instance of adaptability to special work was that of a motor truck which not only hauls long poles used in shoring up trenches for sewer connections, but sets them in, and extracts them from the ground, by its own power. Previously this work required several teams and a crew of six or eight day laborers under a competent foreman. The truck, however, with its complete outfit of poles and other mechanical devices for accomplishing this work is, in reality, a moving headquarters for all the men and machinery necessary to finish the work as it goes on. It has also been used with trailers to carry an all but endless supply of poles, pipes, and equipment. (Figure 7.)

(4) *Regularity of Service.* Another advantage which the motor truck has over horse-drawn delivery is that of regularity of service regardless of weather conditions. There are several conspicuous installations which have been developed as the result of this advantage. In certain cities throughout the United States, the Post Office has contracted with motor delivery companies to call for mail at the various post offices and substations and deliver it to the railroad stations, which must naturally be done on schedule time. Before this method was adopted it was not uncommon to see the horse-drawn mail wagons delayed several hours by severe snow storms in the winter time, resulting in failure to make connections and great irregularity in the dispatching of mail. A department store in Chicago prides itself on its ability to carry out its promises of

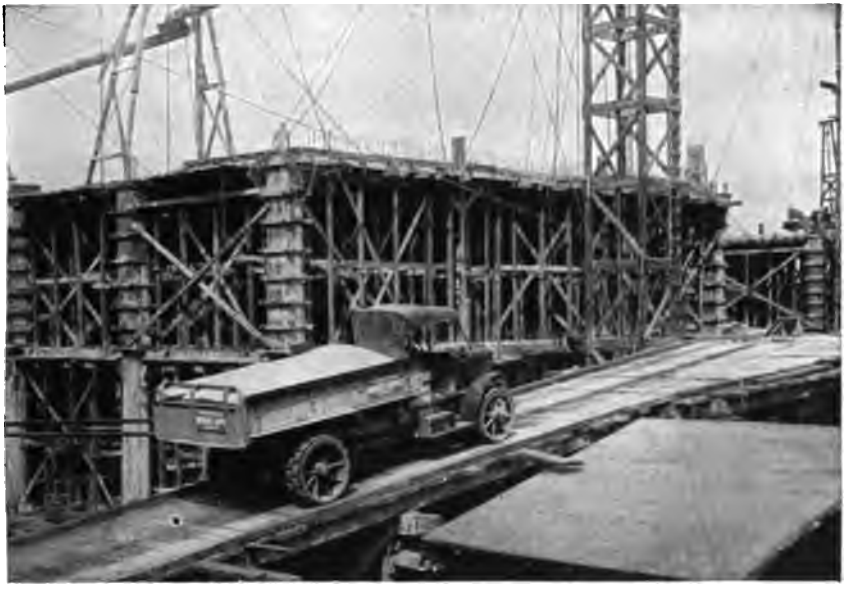


FIGURE 6: Adaptability is one of the prime qualities of the motor truck. It would have been dangerous, if not impossible to use mules on this runway. The motor truck, however, negotiates the grade with ease in the limited space.

FIGURE 7: Setting telegraph poles by motor truck is a not uncommon sight in these days. The power of the truck's engine, transmitted through a winch with a long cable, hoists the pole to a vertical position, into the excavation.

FIGURE 8: Advertising is one of the "by-products" of motor truck operation. This truck, by means of a specially designed body, advertises its owners effectively. Many products lend themselves to this kind of treatment.

FIGURE 9: This truck made a special trip from Chicago to New York to advertise a line of nationally advertised products. It received wide publicity and demonstrated the advertising possibilities of motor trucks.

delivery to its customers. A schedule department has been established in the shipping room and clerks in any part of the store may telephone to the chief shipping clerk and learn when a given package, if delivered to the shipping room by a special messenger, will reach its destination. The clerks can then inform the customers and so reliable has this service become that customers can depend implicitly upon what they are told and thus decide whether they will be best served carrying the package home or by having it delivered by the store.

Coal companies in Chicago delivering coal to the office buildings and retail stores in the loop district where the storage space is limited, have found it possible to establish regular schedules for delivery which are almost never upset due to weather conditions, either in the heat of the summer months or the extreme cold and stormy weather in winter. In fact, it has been stated by architects and contractors of national reputation that were it not for the improvement made in the handling of coal and other supplies for office buildings in this respect, the development of the skyscraper to its present proportions would have been impossible.

A motor haulage contractor operating between Cleveland and Akron, has, by the regularity and flexibility of his deliveries, calling for goods and delivering them when and where desired, built up a fleet of nearly fifty trucks which are operated night and day, giving more satisfactory service to patrons in both cities than the express companies have been able to give, owing to the enormously increased output of rubber products, which has taxed the capacity of the express companies to the limit.

(5) *Greater Effective Range.* Perhaps no single factor has been more successfully used in persuading merchants and manufacturers to change from horse to motor delivery than the greater effective range of the motor truck. Many retailing establishments have made use of this feature in their delivery systems. It would be possible to cite one example after another of department stores, grocers, coal dealers, and the like who have extended their business to several communities by means of motor truck deliveries. It is only necessary to imagine what would happen in making deliveries on the part of such merchants if they were suddenly to be deprived of their motor installations.

Again, scores of companies have sprung up, announcing that they are prepared to haul goods to points, not dozens of miles,

but hundreds of miles away. For example: the Cleveland-Akron-Canton Transfer Company recently announced that they were prepared to haul express and fast freight to and from Cleveland on the north, to Canton on the south, and east to Alliance and Youngstown. Not only that, but this company had made arrangements with another transfer company, the Highway Transport Company of Cleveland, by which the territory along the Lake Shore route, from Conneaut on the east to Sandusky on the west will also be reached by their service.

The two companies operate over 250 miles of highway with service that handles express at a lower rate than the railroads, and twice as quickly. An official of the Akron Company says:

"In addition to the present territory covered, we hope to be able in a short time to add Toledo, and it would not be a surprise to me if, by arrangements with other companies, we would be shipping to Detroit and Chicago within six months. This may sound like fancy, but it is quite within the realm of possibility. We have been doing long distance work for almost a year, and have transported goods for the big Akron rubber companies that could not have reached their destination in time by any other way. Our goods are all insured in transit and are protected from the elements."

So important is this new field of the motor truck and so boundless its opportunities that a special chapter has been devoted to this angle of the motor truck's development.

(6) *Publicity Value.* The advertising value of motor trucks is apparent because of the wider area of territory covered by these constantly moving billboards, and the impression they give that the merchants using them have the same progressive standards in their buying and selling policies as in their deliveries. (Figures 8 and 9.)

Two of the most recent types of converts to the use of motor delivery are the dyers and cleaners and the retail drug stores. In the case of the former, their advertising is frequently based on their ability to call for garments to be cleaned or pressed and return them in good condition the same or the following day. Furthermore, it is not uncommon to see drug stores of the more progressive type advertising the fact that when requested by telephone their machines will call for and deliver prescriptions with the least possible delay. Certain well-known companies with branches in various parts of the country, such as packing houses and oil companies, have their trucks all painted alike in some conspicuous color, which is of distinct advertising value. When one of their machines passes, it is immediately

recognized by its unusual color and in the course of time their products become associated in the popular mind with the fact that they are being delivered promptly and efficiently.

Performance Favors the Motor Truck. Knowing all these advantages in favor of the motor truck, it will be found that either a given amount of work is done more quickly for less money or that more work is done than could be performed by horse and wagon for the same money. In other words the factor of economy per unit of work is nearly always present on the side of the motor. Not infrequently the motor truck offers combinations of these advantages which are inseparable.

No better summary of the advantages the average merchant may gain from motor trucks may be found than that given by a retailer in Nashville, Tenn., who was asked to give his reasons for changing from horse to motor delivery. He said:

"I could give many reasons, but the following are the most important:

"I found that I was losing business to competitive firms that used motor truck delivery. This set me to thinking.

"I found that trucks were being successfully used in practically every line of business and as a result I tried them in mine.

"I found that I could cover more than twice the ground that I could with horses and that I could reach districts from which I had never been able to draw any business before.

"I found that I could make more frequent deliveries and give better service to my customers because the truck covered the ground in less than half the time my horses did.

"I found that trucks were absolutely reliable and that with proper care I could have every truck on the job every morning.

"I found that during the rush season I could work my truck twenty-four hours a day if necessary, while horses needed relief after every twelve hours' work.

"I had always used horses, yet I had never stopped to figure how much they cost me. I found that there were many extras which made a costly total at the end of the year.

"I found that I saved money by the installation of motor transportation.

"I found that each truck replaced three or four wagons. This cut down the number of men on my payroll.

"I found that trucks cost only when they were in use, while my horses ate their heads off on Sunday and required attention day and night.

"I found that I could give up my big stable, which had to be close at hand, and take a smaller garage, where rents were cheaper, because trucks could cover the ground quickly and easily without tiring.

"I found that, although my investment in trucks has yielded big dividends in money saved, it has yielded me greater dividends in the increased efficiency of my delivery service.

"From my experience no petty saving in operating expense would ever compensate me for returning to the infinitely inferior horse system of delivery.

"You will find these same things will hold good in your line of business if you give trucks the chance, and for the sake of your business I urge you to investigate."

Motor Trucks and the Great War. While the motor truck has proved its efficiency in almost every kind of business, it owes the most sensational and conspicuous demonstration of its worth to the Great War, and this is not particularly surprising. For war is business, and efficiency must prevail: organization, precision, dispatch and transportation determine the success of armies. Not only must great bodies of troops be hauled from place to place, but an enormous amount of munitions, equipment, food and engineering material must be quickly transported. War permits no sleepy traffic manager, because thousands of lives depend upon his efficiency. Moreover the motor truck is the chosen agent for army transport, because it has proved that it is stronger, that it can haul faster, and is better able to meet the conditions found on the field of battle than the army mule. (Figure 12.)

The use of the motor truck in the Great War has demonstrated its merits to the public more than many thousands of full page advertisements. The business man finds more convincing proof of the utility of the truck when he realizes that the conditions met with at the front, are often much worse than those encountered in his own business. An army truck must do more than haul an average load over an average road. It must at times plow its way hub-deep through mud, extricate itself from shell craters in the road, haul heavy cannon over rough ground where it was thought that only the sharp hoofs of dozens of mules could provide the necessary motive power; pull behind it many loaded wagons in a train, surmount steep grades and above all, continue without interruption. (Figure 10.)

Thus the business man with his comparatively small delivery problems may learn much from the experience of the general who has more to gain and far more to lose in selecting his means of transportation.

The field of the truck in business today is wider than that indicated by its ability to haul goods more cheaply than the horse. The true value of motor haulage cannot be arrived at until all the factors are taken into consideration. Many of these cannot be assessed in terms of dollars and cents.

FIGURE 10: "Straight ahead" must often be the route of the army motor truck. And it takes power to "obey." Streams must be forded and muddy fields crossed and that is why 90% of ordnance trucks are of the four-wheel drive type.

FIGURE 11: Who knows but what this motor truck may have won a battle! In Chapter 32 is a description by a well-known war correspondent of the real work motor trucks did at the battle of Verdun to save the day for the Allies.

FIGURE 12: The same qualities which make motor trucks effective in business, convert them into valuable allies in times of war. As a method of transportion of everything movable they have greatly increased the resourcefulness of armies.

FIGURE 13: In winter the horse falls on the icy streets, in summer, on the hot pavements, and then follow delays, traffic blockades, and serious economic loss. Often the policeman's pistol brings a sudden end to the animal's usefulness.

Why the Horse is Being Supplanted. Certain facts about the horse are disquieting. While the horse may last twenty years, his period of efficient service is about six and if he is overworked, he may not last three. Although he may travel thirty or forty miles in one day, he cannot do it the next, and, in fact, he cannot be counted on regularly to deliver more than twenty miles per day of service. Unlike the truck, he cannot be indefinitely speeded up. Quick loading and unloading devices in connection with the horse might as well be thrown away: they only speed him to the boneyard. The horse gets sick from overwork, also from underwork. He slips and falls on the icy streets in winter; he is prostrated in the summer; he is the source of uncleanliness and expense to the city; he obstructs more rapid traffic and causes serious congestion. As a motor he is only 2% efficient. (Figure 13.)

Moreover, he demands an enormous amount of food. One horse consumes in a year the product of five acres. The 25,000,000 mules and horses in the United States would require for their sustenance a single farm the size of Iowa, Indiana, Illinois and Ohio combined. While his cost in the last ten years has increased 143%, he is no more efficient than he was thirty or three thousand years ago.

These considerations are coming home to the modern business man because they affect his profit. And transportation, according to the Federal Trade Commission, is just as much an element in the final cost of goods as any of the processes which go on inside the factory or the store, which are generally so carefully watched and speeded up. In these days of intense competition, therefore, the progressive manager is turning his attention to his delivery equipment. In the following pages, we shall present some considerations which will enable him, if he still delivers by horse and wagon, to consider whether he cannot profitably change to motor delivery. If, on the other hand, he has already motorized his delivery equipment, we shall try to give him here the experience of others who have analyzed and made the most effective use of this modern instrument of competition.

CHAPTER II

WHEN TO CHANGE FROM HORSE TO MOTOR DELIVERY

HAVING briefly outlined the development of the delivery problem in business from the earliest times known in history to the present day, let us consider the question that confronts thousands of merchants in facing the future growth of their business: "Shall we install motor trucks, or shall we continue with horse delivery?"

It is our aim in this chapter to analyze the fundamental questions involved in this problem in such a manner that these merchants may apply certain basic principles to their own situations and arrive at a decision upon which they can depend.

When Should a Motor Truck be Installed? It is only fair at the outset to admit the impossibility of setting down any hard and fast rule which covers all the possible cases that might come up for consideration. Every one is a law unto itself, and every one requires individual scrutiny and analysis. Often two dissimilar delivery problems are equally adaptable to the economical use of motor trucks. There are a dozen or more features to each problem which must be considered and every one must be given its due weight. It will not do to say, "As this man has long hauls, he therefore needs trucks"; or, "As this man carries heavy loads, he therefore needs trucks." It may be that the long hauls are made upon crowded streets where the speedy truck has to crawl along behind slow-moving dray wagons, or the heavy loads may be hauled no farther than around the corner.

What makes the problem pressing is the knowledge that the horse is considered, by his own performance, a wasteful machine. As a motor he is but 2% efficient so far as heat units are concerned. That is, of the heat energy taken in with his enormous meals he transmits but 2% in drawbar pull on the vehicle behind him. His limited hours of labor and his comparatively small

capacity for load and speed, considered in connection with the expense of feeding, caring for, and housing him, as well as his bulky vehicle and harness, condemn him at the start for inefficiency in transportation.

Conditions of Business Must Govern Decision. On the other hand, the principal advantages of motor transportation are conspicuous. The mere economy in garaging these compact engines, requiring as they do about one-eighth the space of the horses and wagons they replace, is a notable item. Instead of being 2% efficient, they transmit from 50% to 75% of the energy of their "meals" into action. Moreover, their great speed and their tremendous capacity for load make them veritable giants in transportation. The mere fact, however, that the motor truck is potentially fifteen to twenty times more efficient than the horse does not clear up the perplexity of the progressive business manager who is studying his delivery problem. The greater question still remains to be answered: "Are the conditions of my business such that I can take advantage of this superior efficiency of the motor truck?" Here he is asking a question which cannot be answered by a simple yes or no. It can only be answered by a careful examination of the several phases and conditions under which the transportation end of his business is operated.

At this point the average business man needs the technical assistance gained by experience. The capable truck salesman, acknowledging this fact, spends as much time in going over the special requirements of his prospect's business as he devotes to the description of the superior qualities of his truck. Fundamental facts are investigated, as they are more important than the particular features of any truck. Such an examination is made not without difficulty. It is possible, however, to lay down a principle and apply it, using it as a guide rather than a hard and fast rule. This guide is the principle of motor truck efficiency.

The Relative Efficiency of Truck and Team. The reason for the existence of the motor truck is that it carries more and goes faster than a horse and wagon. This is its fundamental justification. A truck constantly working with a capacity load attains the maximum of efficiency. According as it is interrupted in its daily travel and according as its load falls below its rated capacity, by so much does it fail to realize the 100% efficiency of which it is theoretically capable.

Let us compare, for instance, a single horse and wagon capable of carrying a half ton at a speed of four miles per hour, with a 2-ton truck which is able to carry two tons at a speed of twelve miles per hour. Using the speed and load of the horse-drawn vehicle as units of comparison, we find that the truck develops three units of speed and carries four units of load. Carrying out these figures, we find that the 2-ton truck performs twelve units of work as compared to a single unit performed by the horse and wagon. This comparison will be clearer if we take another case and consider that the truck carries four times the load, but develops only the same speed as the horse and wagon. In that event the truck does four times as much work as the horse and wagon. Now, if this speed is increased to three times that of the horse it will be seen that the truck not only carries four times as much but carries it three times as fast as the horse-drawn vehicle, making the relative working efficiency of the truck twelve times that of the horse.

Let us now suppose that this truck, which is capable of thrice the speed and four times the capacity of a horse and wagon, carries its load at a rate of eight miles an hour. Inasmuch as it develops twice the speed of the horse and carries four times the load, it still performs eight times as much work as the horse. Imagine that this truck runs twelve miles an hour all day, but carries 1½ tons in the morning and a half ton in the afternoon. Its load for the day is one ton, which is twice the capacity of the horse drawn unit and with a speed of three times and a load of twice the horse capacity, it does the work of six horses even though half the day it carried a load less than its capacity.

Formula for Truck Efficiency. With these facts in mind we are able to produce what may be termed a formula of motor truck efficiency, using the efficiency of a single horse and wagon as a standard. This formula may be expressed as follows:

SPEED		LOAD		WORK
As Compared with Horse	×	As Compared with Horse	=	As Compared with Horse

Or, leaving off the explanations, which are now understood, we may say that SPEED × LOAD = WORK.

This elementary formula, while not conclusive, will prove, we believe, decidedly valuable as a guide to the business manager in analyzing his delivery problem, lest he go astray in the intricacies of a confusing analysis. Transportation engineering

FIGURE 14: The motor truck is not limited to an eight- or ten-hour day, as are horses or mules. Many concerns employ shifts of drivers, install artificial lighting and work their trucks day and night if an emergency should require.

FIGURE 15: The motor truck created this industrial landscape. The crane, the grab-bucket and the hopper are all assembled for the one purpose of conserving the time of the truck which may be worth as much as $10 an hour.

FIGURE 16: Imagine two wagons and eight mules in this limited space. The narrow and steep grade would make a great deal of maneuvering necessary. All this confusion is eliminated by the motor trucks.

FIGURE 17: Compactness is one of the great advantages of the truck. Imagine several teams of horses or mules pulling this load up this narrow incline. What confusion, excitement and costly delays would follow!

is not an exact science, although it is far better understood now than ever before. Many variations will develop in different lines of business as a result of which the formula above may not accurately disclose the result sought.

In applying this principle to any delivery problem, the investigator should remember that a truck seldom develops anywhere near 100% transportation efficiency. Considering that such a truck would travel four times as fast and carry four times the load of a single horse and wagon, we arrive at the astonishing fact that this single truck would replace sixteen single-horse wagons. If a power wagon system could be operated on such a basis, no problem would be involved, and it would pay at once to substitute it for the horse-drawn system. One should not, however, refuse to consider the possibilities of a motor delivery system merely because, early in the examination, it is discovered that the trucks must carry less than their capacity load and stand motionless much of the time. The problem requires careful accounting to discover what conditions have a bearing on the basic formula.

The following are the most important external factors which affect the speed or load of trucks and consequently affect the work or returns to be expected from them:

(1) *Size of Business.* Obviously the size of a given business determines whether there is a transportation problem big enough to involve the use of even one truck. As a general rule a merchant having more than two single-horse wagons should begin to give consideration to the question of motorizing his delivery. It is generally said that one truck will replace four such wagons. No one can say definitely how many teams can be replaced by one truck, except in a given instance. There are certain kinds of business, notably freight and transportation lines, in which one truck has replaced sixteen single-horse wagons. The size of the business, however, gives one merely a preliminary idea as to the advisability of motorizing. A further analysis of the conditions of delivery is necessary before a conclusion can be drawn.

(2) *Long Hauls.* The condition most in favor of motor truck operation is one involving long hauls. In fact it may be almost said that anyone having to make long hauls in his business should motorize at once without further debate, as the case for trucks is practically settled by the mere statement of this condition. In making long hauls the truck has the chance to show

the speed which is half the secret of its efficiency. Even if the other half—the capacity for load—were entirely missing and it carried merely the cargo of a single horse and wagon, it would still do the work of four or five horses, because it would operate from four to five times as fast. Commonly, however, it has a good load to carry as well, in which case both factors of our formula, speed and load, are present, making the resultant product, "work," very high.

(3) *Short Hauls.* Transportation involving short hauls is the obverse of the medal, and as a general thing represents a condition unfavorable for the operation of motor trucks. The factor of speed is of course the most noticeably affected. In going short distances the truck has scarcely time to get up to high speed when it has to stop. Of more serious consequence than that, however, are the stops made to deliver goods. Frequent inaction, of course, reduces the average daily speed just as effectively as slow driving. If a truck were going at full speed half the time and were inactive the other half, its daily speed would be computed as one-half its potential speed.

The experience of many concerns is worth noting, however, that deliveries made to several points which are over three ordinary city blocks apart are just outside the classification of short hauls, and at these distances, limited though they may seem, a fast truck can often perform to such advantage that its substitution for the horse and wagon will prove advisable.

(4) *Combination of Long and Short Hauls.* It sometimes happens that although business requires long hauls to certain districts it becomes necessary to make many short hauls and stops in the course of actually delivering the merchandise. In such cases it is necessary to figure carefully to prevent the error of buying and using trucks wastefully. Obviously while the truck is spinning along at its maximum speed and with a capacity load toward the region in which the distribution of goods must take place, it is developing its full working efficiency. Once arrived there, however, and employed in making house to house deliveries, it becomes scarcely more efficient than a single horse and wagon. Its speed, which is its chief asset, is cut down to almost nothing. And more than that, its load suffers a gradual reduction over a long period of time so that in many instances a truck engaged in deliveries of this nature may work a whole day with an average load of but half its capacity.

Many traffic managers, when confronted by a situation of this kind, employ one or two trucks to make trips at high speed along the radii which lead to the outlying districts where actual deliveries must be made. Once loaded, these trucks without stopping deliver their entire burden to suitable stations from which, after redistribution into small units, it is taken up again by horse-drawn vehicles, more suited to the work of house to house delivery. Department stores which make deliveries to distant suburbs sometimes find it profitable to use small, fast delivery cars exclusively. Electric vehicles have been found particularly economical for this service. These machines, to begin with, cost no more than a good horse and wagon equipment such as they would otherwise have to maintain. There would be no economy, therefore, in transferring a load from one conveyance to another of similar capacity, while such a method might involve a decided loss, due to the slower pace of the horse delivery, and to the longer hours of the driver and helper.

(5) *Road Conditions.* Bad road conditions may sometimes affect the efficiency of motor trucks by cutting down their speed or by making necessary frequent overhauling and adjustment of their mechanical parts. There are very few cities in this country in which the imperfect road conditions are a serious obstacle to the introduction of motor trucks, provided other business conditions would justify their use. In fact, in typical American fashion, certain cities whose normal growth and development have been hindered by the burden of old and worn-out pavements which have prevented the use of motor cars and trucks have recently appropriated large sums of money for repaving with a view to overcoming these handicaps. Such difficulties are too often magnified out of their true proportion, however, and many a merchant who looks with dismay upon temporarily unfavorable road conditions allows himself to be frightened away from an aid which might save him hundreds of dollars in his annual transportation bill.

Again, steep grades may make it necessary to haul loads of less than the normal rated capacity of a truck. This apparent disadvantage may be overcome by other conditions, which in comparison with horse-drawn service, stamp the truck as much more efficient than the horse. For example: In the sultry, withering heat of summer the truck when traveling up grades doesn't require the frequent rests and consequent loss of time

necessary to prevent prostrations, while past performance has abundantly proved the dependability of the motor in conditions of snow and ice which render the horse highly uncertain and far less powerful, even when sharp shod.

(6) *Idle Time.* It sometimes happens that the pressure of business varies greatly during the course of every day, so that while a truck may make a long and profitable trip at one time of the day, it may stand idle a large part of the time. This is, of course, not a favorable condition for truck operation, although it cannot be adjudged so in any particular case without careful accounting. Idleness, or its equivalent, slow motion, may also be produced by the congestion and delays often met with at freight terminals and docks, or on crowded streets, to say nothing of the greater delays often occasioned by the condition of the merchant's own shipping and receiving departments.

While all these factors should be recognized and introduced in our formula at their true value, the merchant should early realize that the advent of the motor truck means a new order of things with regard to shipping facilities and delivery programs. The horse has long been with us, and the impress of his personality and slow ways still remains on our commerce. His lagging pace, his limited capacity for load, his limited hours of labor, and most important of all, his low cost and that of the vehicle he draws—all these things have been faithfully reflected in our shipping rooms, our shipping clerks, our freight docks and our terminals.

The motor truck is comparatively expensive. It commonly replaces three or four wagons; and when it is standing still, four horses are lying idle. It is capable of good speed and enormous loads. It asks for work; and when given its capacity it starts complacently away with a cargo which five horses could hardly stir, and carries it four times as fast. By doing these prodigies it can even stand idle at our horse-planned shipping rooms and freight docks, and still, out of the bounty of efficient performance when in action, declare the merchant a profit. Idleness, however, is a spendthrift waste, and one which should be eliminated.

The merchant, therefore, has to approach this question of idle time from two points of view. While he must faithfully recognize those factors in his business which may prevent his giving steady employment to one or more trucks, he must also look sharply into every department of his business to see whether it cannot

FIGURE 18: Speed! If a fire breaks out or an accident occurs, this truck must be on the spot and secure a photograph at the earliest possible moment. "Photograph Patrol" is the name applied to it by the newspaper which owns it.

FIGURE 19: A striking trademark or slogan painted on the side of a motor truck is always effective. A truck in a large city gets a "circulation" of many thousands, and, except for the initial cost, secures free advertising for its owner.

FIGURE 20: Here is another type of special army truck built for the United States Army. Note the strong, light, steel wheels which are a special requirement in the specifications of the Liberty truck. Another type is shown in Figure 308.

FIGURE 21: The words "United States Mail" which appear on the sides of this fleet of trucks form one of the best indorsements of the field of trucks that could be asked for. The Post Office Department owns and operates thousands of trucks.

be rearranged or "speeded up" so as to enable him to take advantage of this valuable machine in transportation.

Proper planning of deliveries may make it possible to keep one truck busy all day, eliminating as many as five horses. Problems which require more flexible treatment may often be solved by a combination of truck and horse systems, as was suggested in the case of the merchant who had to transport his goods several miles from his store and then deliver them practically from house to house. The average merchant may be surprised to discover, upon examination, that his present delivery system is capable of alteration. And it is the exceptional business using at present three or more horses, which cannot, by careful and creative planning, be made to accommodate a motor delivery system with better results. The merchant who does not conscientiously examine his own business with that idea in view is cheating himself of an opportunity which his keener competitor may be using against him.

Besides replanning deliveries, it is generally necessary to revamp the shipping room. The average shipping department is dominated by the very spirit and presence of old Dobbin. Here easy customs prevail. The average traffic manager suffers no special pang to look out upon his horse and wagon standing idle perhaps an hour before being loaded and another half hour while being unloaded. Progress has changed all this. In the larger centers, where motor delivery is practically universal, we see traveling belts, gravity chutes, and spiral slides, escalators for carrying heavy articles, and various other devices for feeding the cargo onto the waiting truck in a fractional part of the time in which the grocer loads his wagon. In many cases elaborate apparatus cannot be installed, but the business manager may as well absorb the spirit of such devices and infuse it into his shipping department, so systematizing it and speeding it up that the load shall be waiting for the truck, and not the truck for the load.

(7) *Variable Loads.* Just as idle time affects the factor of speed in our formula, so conditions involving a wide variation in the amount to be carried affect the factor of load. Consequently if the load factor falls below what might be called an average load for two horses, the resultant product of work will doubtless be so small as to render the use of a motor truck unprofitable. If, however, the truck is constantly busy with an average single-

horse load, it may still operate more advantageously than horse delivery, because the truck is able to do the work of four or five horses by means of its four- or fivefold greater speed. If, therefore, a given transportation problem involves the moving of widely variable loads, the most satisfactory solution is to be found through the use of trucks whose capacity is somewhat under that of the average load to be carried. Rather than employ units which can, in one load, carry away bodily the accumulation of a day's freight, it is considered better practice to have two or three smaller trucks which can keep busily pecking away, moving part of the merchandise, at the same time leaving a certain amount behind, like a balance in the bank. If the factors of load and speed are thus kept up to a fair average, the resultant amount of work produced is considerably greater than would be economically possible by means of horses.

This principle, though, if followed blindly, will lead one into difficulties. If a man wishes to move four tons of reasonably compact merchandise it is, generally speaking, cheaper to use a single 4-ton truck than two 2-ton trucks. Where a load of definite size and weight can be depended on, the most satisfactory course is to buy a truck to fit that load. It would not be economical to employ several trucks every day moving merchandise that one truck of the proper capacity could carry.

Merchants who have a large business but still have the problem of variable loads to contend against, sometimes use one large truck and several small ones. The large truck may be moving capacity loads, in the most economical fashion, while the smaller trucks when not engaged, are not so expensively idle.

(8) *One-Way Loads.* Although a business house having one-way loads to contend against has an expensive transportation problem to begin with, the use of motor trucks should be seriously considered, especially if long hauls are involved, in which the trucks may develop fairly high speed. Many truck lines do a one-way business and show a profit over horse and wagon, solely because of the speed factor.

(9) *Increase of Business.* There is another consideration, however, which is altogether separate from the matter of truck efficiency, but which may prove to be more important than all the factors which we have considered. This is the possible increase of business afforded by the comparatively greater field of operations of the motor truck.

It can be readily seen that if this increase of business amounts to much, the additional profits may take care of the entire expense of the transportation, making it a sort of free gift to the business. We are inclined to believe this phase of the question deserves more and receives less consideration from the business man than almost any other. This is perhaps because it requires creative imagination. The merchant, however, who knows how to reckon on this future gain is doing creative planning of the highest order, and may expect rewards in proportion.

Applying the Principles. We have now indicated the most important conditions of business operation which affect the speed and the loading of motor vehicles, and consequently their work.

The manager who will apply these principles to his own business can tell with reasonable certainty what motor trucks will do for him. His problem from now on is one of accounting.

The formula Speed × Load = Work has served its purpose, for it has told the merchant what part of the possible 100% efficiency of motor trucks the conditions of his business permit him to obtain. With a view of answering the question at the beginning of this discussion, he must now figure out in dollars and cents whether the work of trucks compared with their cost exceeds the work of his horse delivery compared with its cost. It is apparent that whatever we may say against that discredited animal, the horse, we must take off our hats to him in this one respect; he is still the standard by which other means of city and suburban transportation are judged, according to cost and according to results. The question then is, how does the cost of motor delivery compare with that of the horse standard?

We can do no more in this chapter than indicate the points which will come up in such a comparison. The cost of his present equipment is presumably known to the merchant. The feed bills, the stable rent, the wagon repairs; these should appear in concrete form on his ledgers.

Estimating the Cost. The cost of the new equipment is not known but may be estimated closely. The first cost of the trucks is, of course, to be had to a penny. This, however, should not be charged against one year's expense, but should be distributed over the years which can confidently be expected as the term of life of a good truck. The old equipment must be disposed of, perhaps all at once, perhaps gradually. Certain

expense will be incurred in making over the shipping room to accommodate this new type of transportation service. As to the cost of operating the trucks, reliable estimates may be made. Certain things are already known to him: such as wages, interest, and terms of payment for the trucks. To these he must add such factors as garaging the trucks, keeping them in repair, and charging off the proper amount for depreciation.

Knowing the cost of his present equipment and the results he is getting from it, and having estimated the cost of a truck delivery system and the results to be expected from it, he is thus in a position to make a reasonably convincing comparison, which should enable him to decide intelligently whether to install motor trucks or continue with his horse delivery system.

CHAPTER III

COMPARING COST OF HORSE AND TRUCK DELIVERY

"WHAT does it cost to deliver my goods to market?" This is the master question, whether the business man operates horse-drawn wagons or motor trucks. It is the all-important question if he is considering replacing his horses with trucks. For before he can decide whether such a step will be good business he must determine as nearly as he can the cost of motor truck delivery. But that is not all. He must also know the cost of horse delivery, if he uses horses, for he must make a comparison between the two kinds of delivery systems before he can intelligently determine which is the better for his business.

Figuring costs does not come naturally to the average truck or team owner. He is accustomed to using the back of an envelop when casting up expenses. Four or five items generally complete the list; then a line is drawn, and a total put down. Sometimes the sheriff has to supply the accounting which the owner disdained.

The Importance of Accurate Costs. Often the very shrewdest business men are lacking in a proper appreciation of the necessity of keeping accurate costs. As a result, they often cheat themselves, for, it should be observed, errors in cost-keeping are pretty generally apt to be errors of omission—the truck or team operator leaves out three or four items of expense which are invisible to him, or which he only imperfectly understands. As a result he sells the services of his equipment too cheaply, and instead of realizing a profit, it often happens that the money he receives does not even equal the money which is going out—some of it visibly in the form of wages, some of it invisibly in the form of depreciation and other expenses.

The matter is so important that it is worth while to relate at length the experience of a truck owner in Detroit who, for lack of proper appreciation of what constituted the cost of operating

his 5-ton truck, was renting it out occasionally at a figure which represented to him a loss of $1 per day instead of the profit of $5 which he had assumed the truck was earning.

This truck operator, whom we will conceal under the name of Perkins, was asked how much it cost him per day to operate his 5-ton dump truck.

"Seven dollars a day," he replied promptly.

His questioner, who was in charge of a large fleet of trucks in the same city, looked surprised and said,

"That's queer. I am in charge of a fleet of 5-tonners, and I can't get below $16 a day per truck to save my life. How do you do it? What's your system?"

"Sixteen dollars a day!" said Perkins, in amazement. "That's awful. There must be something the matter with your system of looking after your trucks."

"That may be," said the expert, smiling, "But let me see a table of your costs. If your system can save $9 a day, I want to learn it."

"Why, I haven't got any system," said Perkins, "and as for my expenses, I can figure them on the back of an envelop."

Perkins drew out an old letter and with the stub of a pencil figured out a table of expenses which is reproduced in the sketch on page 37.

Perkins handed the envelop to his questioner and said, "There it is. There isn't much system to it, as you can see, but there's the figures. Figures don't lie."

"They're all right as far as they go," said the expert, "but there aren't enough of them. You've left out some things."

"Is that so?" said Perkins, "I suppose since you accountants have got into the game there's quite a few new expenses invented that we never used to hear of before."

"Let me ask you a few questions," said the expert, whom, for convenience, we will call Johnson. "I don't see any charge here for interest."

"Of course not," said Perkins, "I'm through paying interest. I've bought the truck outright. I've paid cash for her, and she's all mine. I don't have to pay interest any more."

"How much did you pay for it?"

"Four thousand dollars."

"Suppose you had that $4,000 right in the palm of your hand. What could you do with it?"

"I suppose put it in the bank."

"Yes, and you might do better than that. You might invest it in a mortgage and earn 8%. But just to be conservative, let's consider 6%. If you had $4,000 you could make it bring you $240 every year."

"Yes, that's so," said Perkins.

"But as a matter of fact you can't get it because you haven't got the $4,000. It's tied up in your truck. So you see it costs you $240 a year to keep your truck just on account of the interest you lose which otherwise you might be receiving. Now charge this interest against your truck, which will figure about 65 cents per day."

Johnson added the item to the short list on the back of Perkins' envelop.

"Now," he continued, "there's insurance."

"My truck's not insured," said Perkins.

"Well, it ought to be, and if it isn't you ought to be charging off a certain amount each month to take care of possible accidents. But I'm going to assume that your truck is insured. For 40 cents a day you can get a combination liability and fire policy which will give you all the protection you need. So we will add 40 cents for insurance. You should consider yourself lucky that you have escaped trouble so far."

"Now," continued Johnson, "I see no charge here for depreciation."

"Of course not," said Perkins. "I keep my truck in perfect repair."

"That may be very true," said Johnson, "You may replace old parts from time to time and by a general overhauling put the truck in such condition that it is almost as good as new, but all the time there is a general wear and tear going on which no amount of repairing can ever make good. Consider a truck which after a life of six or seven years' active service, shows a hundredth of an inch of wear in every moving part. What can possibly be done for such a truck? Repair it? Nonsense."

"I see your point," said Perkins.

"How old is your truck?" said Johnson.

"Two years old last month."

"Then, to be conservative, let us say that it is worth $1,000 less today than when you bought it. In other words you have spent $1,000 of your investment just as surely as you have spent actual money for wages and gasoline. And yet you have no record of such an expenditure in your costs."

"What good would it do to make a record of it?" said Perkins. "It wouldn't stop the truck's wearing out."

"Very true; but on the other hand it would show you your profits in a true light. Suppose for instance that you have a depreciation of $2 per day. If you do not show it in your costs you may be led to believe that your profits amount to, say, $6 per day. Now if you do show a depreciation charge of $2 per day, you will realize that the figure of $6 does not represent your real profits, but that $2 must be put back into the business for a renewal fund, leaving your true profits $4 per day."

"I see," said Perkins, a little agitated.

"If, on this basis," said Johnson, "you've been spending the whole $6 you have been getting nearer and nearer to bankruptcy every day. You would never realize it until the day came, a few years hence, when your truck refused to move for all time. Then you would realize that you were a ruined man."

"Let's put down depreciation then," said Perkins. "There is no time to lose."

"It is customary to figure depreciation at 20% a year. That is to say, in five years time the whole value of the truck is 'written off.' That doesn't mean, of course, that the average life of a truck is five years. Some trucks don't last that long, but any well-built motor truck, with proper care and lubrication, ought to last seven, eight, or ten years. There are trucks in existence that have lasted even longer."

"It is necessary, however, to establish some basis for figuring depreciation, and inasmuch as this basis is bound to be arbitrary, it is necessary to establish it 'on the safe side.' Concerns which have had a good deal of experience with trucks, and which know how long trucks should last under the special conditions of service peculiar to their business, often establish a basis of their own. Five years, however, is a good working average.

"Figuring at the rate of 20% we have $800 per year on your $4,000 investment. Reducing it to the expense per day so that we can add it to the list on the envelop, we get $2.50 per day."

"That's almost as much as the driver's pay," said Perkins.

"Yes, and you wouldn't think of leaving the driver's pay off your balance sheet."

"What else have I left off?" said Perkins, who now began to realize that he may have been actually losing money in the operation of his truck.

"There are taxes and license fees. They don't amount to very much, but they have their place in the costs. Let us put down 20 cents per day for taxes and license fees.

"Another thing I don't find here is the cost of tires. Why isn't that shown?"

"You see," said Perkins, "I bought these tires last year, and they have lasted over."

"But can't you see," returned Johnson, "that if you want to determine the cost of operating your truck per day, in order that you may know what to charge for the rental of it per day, you must analyze all charges in terms of cost per day. Now your purchase of tires, although made on one day, covered many days. You paid, perhaps $300 for your set of six tires, but in fact it is the same as if you had paid $1 every day the truck was in operation. Your tires cost you not $300 on one particular day but $1 every day."

"You can, of course, figure the tire expense exactly, getting the actual cost for every day the truck is run. This can be done by keeping a record of the actual mileage covered each day and by finding the proportion which it bears to the total mileage which the tires deliver before wearing out."

"This method is rather troublesome as it involves considerable figuring. Moreover, final results cannot be obtained until the tires have worn out and been discarded. A more practical method is to assume that the truck tires will run out the life of the guarantee. Taking 7,000 miles as a basis, the tire cost per mile can easily be figured, and it will hold for the life of the tire. This method also shows up well in cases where tires fail before delivering 7,000 miles. Inasmuch as tires which show defects are adjusted by most of the tire companies on a basis of 7,000 miles, no change is required in the method of keeping track of their cost."

"Let's add to your envelop, then, $1 per day for tires."

"What else can I have left off?" said Perkins.

"This nearly completes the list," said Johnson, "There are one or two things which I'll run over hastily."

"I notice you have no garage rent."

"Of course not," said Perkins, "It's mine. I own it."

"If your own truck did not occupy it, what could you rent it for?"

"Perhaps $1 a day."

"All right then, let's add $1 per day for garage rent."

"There are a few minor items which should be taken into account. Grease and waste together amount to about half as much as oil; the driver undoubtedly earns some overtime each month, and then, unless you have made your item of repairs very broad you have probably failed to include overhauling, painting, and so forth. For the sake of completeness I will add them to your list of costs.

"What is the total? Instead of $7.19, we have $13.29, or 29 cents more than you receive in rental by the day. But even at that you haven't figured all your costs—for there is no helper's wages shown, and a 5-ton truck seldom can be operated efficiently without a helper in addition to the driver. Taking it all together, your costs are as near $16 a day as are my own. You are only receiving $13. You are operating at an actual loss, your truck is depreciating, your investment is vanishing before your eyes, you are headed towards bankruptcy, all because you figure on the back of an envelope. You have not analyzed the cost of delivery."

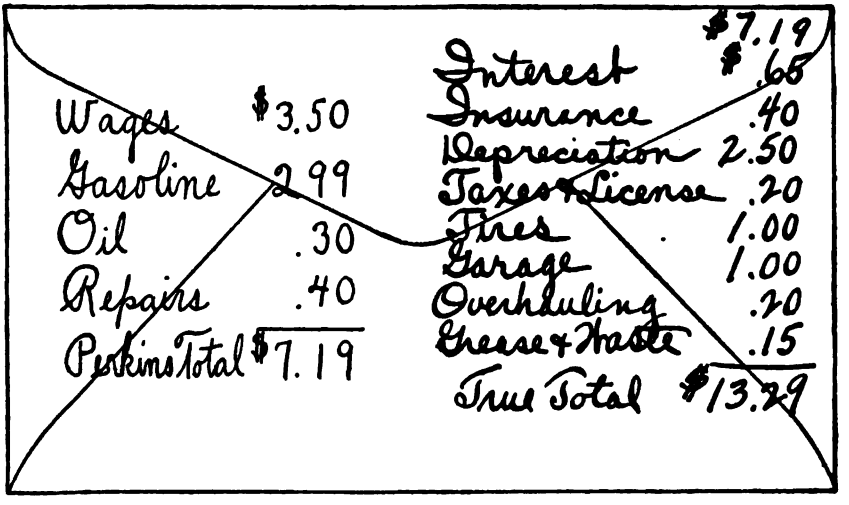


FIGURE 22: On the left side of the envelop is Perkins' idea of what constitutes truck costs. Johnson, the accountant, added on eight items which Perkins had failed to consider, and which finally convinced him that he had been losing money.

The truck owner raised his rates the next day. He had done business for two years at a loss of nearly $1,000 a year. His losses were concealed in the truck. Johnson's analysis of the cost of delivery brought it to light.

This rather lengthy account is presented because the case is typical. There are thousands of truck owners who include in their costs only such visible items as wages, gasoline and repairs. Their losses are concealed in the vehicle itself. For years the

truck appears to be paying a profit. All of a sudden, it fails. It is appraised and discovered to be worthless. Then the owner realizes a loss that previously he had but imperfectly understood.

A Complete Analysis of Costs. Perkins, who discovered the value of analyzing his delivery costs and thus avoided going into bankruptcy, did not install a complicated accounting system. He had not the office, the help, nor the inclination. But he did hold on like grim death to the list of items which Johnson had written down for him on the envelop. "The items are what count," said Perkins to himself, and he was nearly right. "Get a list of the different kinds of expense which apply to your truck, and you can still figure on the back of an envelop," said Johnson.

What are those items, which taken together, constitute the cost of motor truck delivery? The answer is:

(*1*) *Interest*, (*2*) *Insurance*, (*3*) *Depreciation*, (*4*) *Taxes*, (*5*) *Garage Rent*, (*6*) *Overhauling*, (*7*) *Repairs*, (*8*) *Tires*, (*9*) *Driver's Wages*, (*10*) *Helper's Wages*, (*11*) *Gasoline or current*, (*12*) *Oil*, (*13*) *Supervision*.

In connection with the items mentioned above a chart is reproduced in Figure 23 which shows an analysis of the cost of operating a 5-ton lumber truck.

While it is true that costs vary with different trucks and with different conditions of business, they do not vary so much as supposed, and they continue to hold a relation to each other, and to the total cost which the truck owner will do well to fix firmly in his mind.

The Horse, a Standard of Measurement. But it is not enough to know accurately the cost of operating a motor truck. A great many business concerns own horses, which are able to do hauling for a certain amount. Even those concerns which do not use horses must nevertheless take into account what it would cost them if their delivery equipment were horse-drawn. For the horse is a standard, though often a low one, and however efficient and businesslike the motor truck might appear to be, it must be measured by the yardstick of horse costs before an intelligent decision can be reached as to which kind of equipment, will prove more profitable.

What does it cost to run a horse per day? The cost of keeping a draft horse and the cost of operating a business wagon or caravan, would seem to the man not in the drayage or express

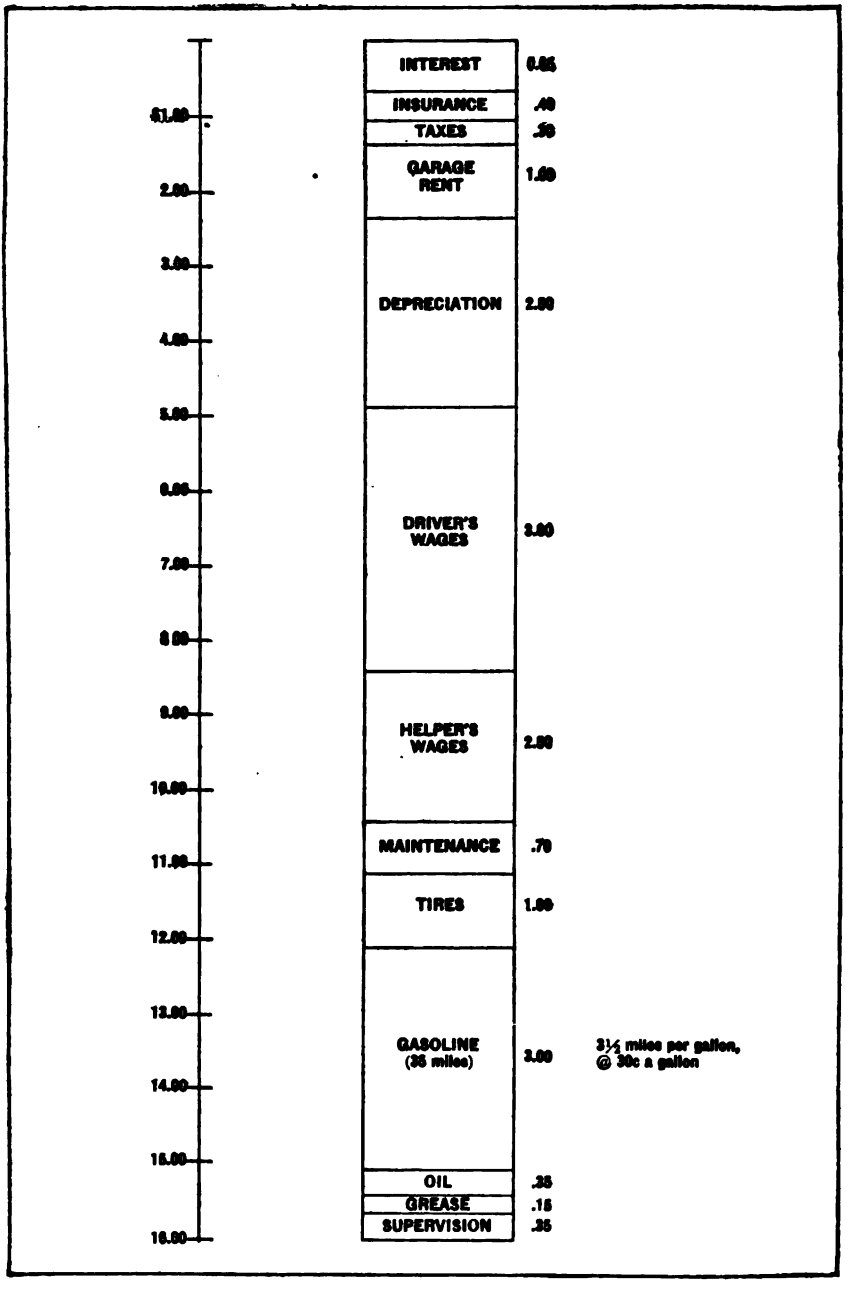


FIGURE 23: How much does it cost to operate a truck today? No one can say, because conditions vary. Here is the cost of operating a five-ton truck used by an eastern lumber dealer which expresses a fair average for trucks of that capacity. No doubt these figures will be helpful to you in charting your own costs

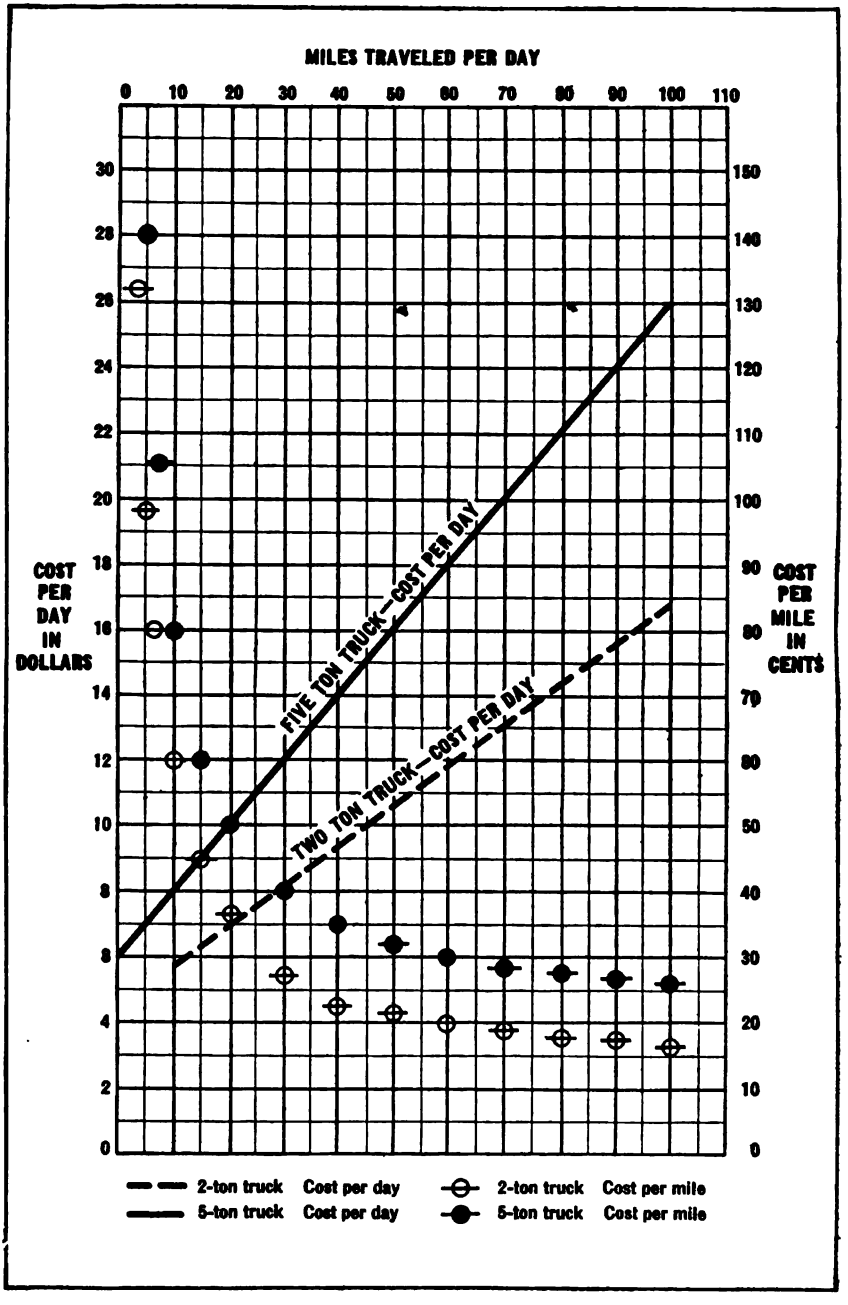

MILES TRAVELED PER DAY
0 10 20 30 40 50 60 70 80 90 100 110
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
COST PER DAY IN DOLLARS
COST PER MILE IN CENTS
FIVE TON TRUCK—COST PER DAY
TWO TON TRUCK—COST PER DAY
2-ton truck Cost per day
5-ton truck Cost per day
2-ton truck Cost per mile
5-ton truck Cost per mile

FIGURE 24: "What will it cost to operate *my* truck?" cannot be answered until conditions are studied. Costs vary for many reasons, but *mileage* is the most important factor. The margin on the left gives daily average cost according to mileage traveled; the one on the right shows the diminishing cost per mile.

FIGURE 25: In changing from horse to motor truck, old-fashioned shipping methods must be given up. This ice cream truck gets its load of salt and ice from an overhead chute in a few minutes' time and is soon on its way.

FIGURE 26: Difficult haulage conditions, such as depicted here, often make it imperative to replace horses with motor trucks. The truck negotiates the steep grade with ease. If horses were used, an extra team would be necessary.

FIGURE 27: Imagine a team of horses pulling this load over snow and ice. Winter conditions have no terrors for motor trucks. In severe blizzards it often happens that trucks are moving when all other transportation is at a standstill.

FIGURE 28: It required six mules to haul as much as did one five-ton truck, and even then the truck traveled four times as fast and worked 16 hours a day with two shifts of drivers, whereas, the teams could work only half that time.

business a very simple problem, and to many in the business it may also seem simple. But when there is such a disparity of ideas that some of the oldest and shrewdest men in the drayage business in a large eastern city, for example, have been known recently to rent out a pair of valuable horses and with driver and all necessary equipment, at a price of $6 per day, and where other men in the same line of business are renting out a similar team for $10 per day, it seems as if there must be a great lack of understanding even among professional teamsters, as to what it costs to run a team per day.

What an Expert Says About Horse Costs. A certain team owners' association having over a hundred members engaged in the teaming business in Boston, recently invited an expert accountant to address their members on the subject. His auditors, many of whom had spent their lives handling horses and teaming for a profit, were astonished at some of the facts brought out by the expert. Here are some of the points emphasized by the accountant which you may read with profit. To start with, there are 365 days in a calendar year. A horse must be fed, housed, maintained, and cared for during the 365 days; but to get his earning capacity there should be a deduction of 52 days for Sundays, and 9 for holidays, leaving 304 effective days. This is actually a reduction of 16⅔% or one-sixth.

Further, for illustration, a large drayage business of, say, two hundred horses must, of course, have from four to six driving horses for use of managers and foremen in properly directing the work. Fourteen spare horses are kept to replace those which become sick. This carries the total of unproductive horses up to twenty or 10%. Now, these driving horses must be fed and cared for, as well as the sick horses, and this takes off 10% more from the remaining 83⅓%, which would leave 75%.

This table, furnished by a truck manufacturer, shows the cost of operating a one-horse and a two-horse team in Boston.

COST OF OPERATING SINGLE-HORSE AND DOUBLE-HORSE TEAM IN BOSTON

	One-Horse Outfit	Two-Horse Team
Driver's pay per day	$2.00	$2.50
Feed per working horse per day	.90	1.80
Rent and stable expenses per day, per horse	.31	.62
Shoeing and small repairs per horse, per day	.19	.38

Claims, accidents, tolls, and so on	$0.18	$0.36
Foremen's and jumper's pro rata per day	.18	.36
Other helpers per horse, per day	.20	.40
Repairs, harnesses, and painting	.13	.26
Managers or superintendents salaries, per day	.10	.20
Office and telephone rent, and clerks	.31	.62
Miscellaneous, veterinary, and the like	.24	.48
Fire and accident insurance	.08	.16
Depreciation for renewals of horses	.20	.40
Total	$5.02	$8.54

A Common Mistake. Here again it should be observed that a great many items enter into the cost of which many a practical owner would never take cognizance. Just as the truck owner, Perkins, figured his expenses as including gasoline, oil, wages, and repairs, so many a horse owner figures feed, wages, and upkeep as constituting his whole bill of costs. Thus, he may claim that, as he owns his stable, he does not have to pay stable rent, and as he puts his own time in perhaps, working fifteen to eighteen hours per day, he is saving a manager's salary. Owners of teams, in fact, are much more prone to neglect the many "invisible" items of expense than owners of trucks. Thus, they assume from the beginning that the expense of horse and wagon delivery is much lower than it really is, and consequently when the inevitable comparison is made between their present delivery cost, and what it would be if they operated trucks, they cheat themselves by concluding that motor truck transportation would be more expensive; whereas, if their horse costs were properly figured, the true conclusion in a vast majority of cases would show trucks to be cheaper than their present horse-drawn system.

Now, it must not be supposed that the cost of operating a 5-ton truck, or any truck, can be represented by any definite figure. Costs vary in different lines of business due to different haulage conditions. One large truck maker, when asked to give specific figures on the cost of operating motor trucks of various capacities, frankly admitted it was impossible to do so. In his opinion, the operating costs of different makes of machines would vary, even though used in the same line of business and under identical haulage conditions. Here are his words:

"Fuel consumption alone may vary over a wide range and instances are recorded where machines of one make show a fuel consumption 40% greater than that of another. Corresponding depreciation is in direct ratio to the quality of the machine and its life expressed in miles of operation, so that this

item varies widely, when applied to the motor truck industry as a whole.

"Another important item in motor truck operating costs is unnatural obsolescence caused by the manufacturer discontinuing business. You can appreciate this when you consider the fact that 42% of all the manufacturers who had entered the industry prior to 1917 remained in business less than one year.

"I am bringing these points out to indicate the futility of attempting to generalize on motor truck operating costs as applied to industry as a whole. On the other hand, motor truck manufacturers whose experiences have been wide and continuous, over a sufficiently long time to establish fundamental cost data should be in a position to estimate quite closely what the performance and operation of their trucks should be when specifically applied. Such statements are purely specific and not generally applicable to other installations, except as an approximation for superficial calculations and estimates.

"With this in mind, we have compiled the chart shown on page 40, showing cost per day and cost per mile for operating 2- and 5-ton trucks for distances up to 100 miles per day. The cost, for any given mileage, will be found in the column at the left of the sheet at the point of intersection corresponding to the point of intersection of the oblique lines and the vertical lines indicating the miles traveled per day. The cost per mile is similarly found in the column at the right of the chart, at the points corresponding to the points where the bisected circles intersect the vertical lines representing the miles traveled per day. For illustration: A 5-ton truck operating for forty miles per day will cost $14, or 35 cents a mile, as determined by extending the points of intersection of the forty-mile line with the oblique line to the left for cost per day and with the bisected circle to the right for cost per mile.

"This chart includes all the usual items chargeable to motor truck operation —interest being figured at 5%, driver's wages at $3 and $3.50 per day for the 2-ton and 5-ton trucks respectively, garage at 80 cents and $1 per day and gasoline at 25 cents per gallon."

It will be instructive to compare the cost of operating a team with that of running a motor truck. How this may be done will be shown in the following chapter.

CHAPTER IV

HOW TO DETERMINE COST OF PERFORMANCE

A ROUGH diagram showing the cost of operating a 2-ton truck and a 2-horse team is reproduced in Figure 29. It will be seen that the team at $7.50 a day costs less to operate than the truck at $10. But is it really cheaper? The answer cannot be had from the information presented in the chart. Although every item of expense which can properly be charged against both truck and team has been set down, there is still something lacking. That something is *performance*. Before either truck or team can be said to be profitable or unprofitable in comparison with the other, the work which each performs in a day must be determined and compared with its cost.

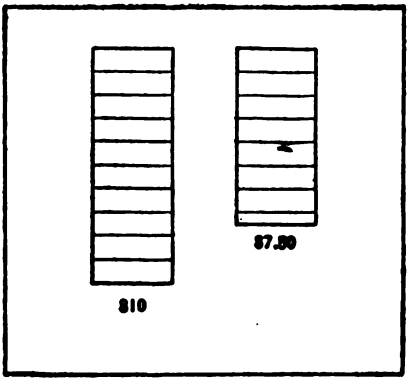


FIGURE 29

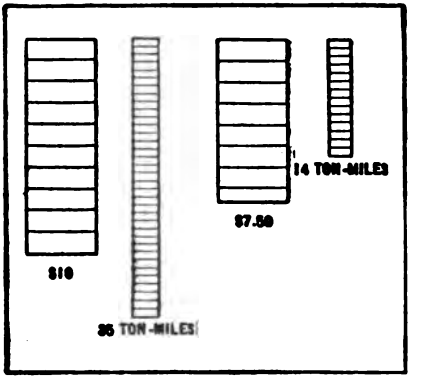


FIGURE 30

In Figure 30 the item of performance has been added. This may represent ton-miles or package-miles, or just plain mileage and is set beside the column representing the cost of operation.

The result can be read almost at a glance, without resorting to measurement and calculation. It is apparent that although

the truck costs more to operate than the team, the work it performs is much greater in proportion. It will pay the merchant to use a truck at say twice the cost of a team if it will perform for instance three times the work.

How to Determine the Cost. Performance, in fact, is the true criterion by which to judge the expense of either truck or team. It is not the cost, but the cost in relation to the work performed which tells the merchant whether his truck installation is saving him money or not.

But although all the items necessary to determine whether, in a given case, truck or team will prove more profitable, are represented in Figure 30, the information is not yet in a convenient form. If a truck costs exactly twice as much as a team, but does exactly four times as much work, the conclusion is easily reached—the truck costs half as much as the team in respect to work performed. But in most cases the proportions are not so simple, and fractions are involved. Suppose, for instance, that the expense per day of operating a motor truck and a team, together with their performance, is represented as follows: Cost of truck $10 in doing 35 ton-miles; cost of team $7.50 in doing 14 ton-miles. It is obvious that these figures cannot be compared in one's mind. One can see at a glance that the truck is more profitable than the team—but exactly how much?

Performance vs. Costs. Looking back at Figure 30, we see that the answer we are looking for is to be found by comparing the column of performance with column of cost. If 35 ton-miles can be performed by a truck at a daily cost of $10, then, to get back to the familiar schoolboy formula, one ton-mile will cost one thirty-fifth as much.

The answer (which is the quotient) is the cost per ton-mile, and it is the final figure for which you have been striving through all your accounting. It is the conclusion and summary of all the information you have collected about your truck. It takes into account all items of cost and performance, such as the cost of gasoline and the delays at your shipping platform; interest, and speed; your driver's wages, and the care with which he drives your truck; depreciation, and the size of the load; garage rent, and the number of customers on your route; cylinder oil and the standing time at the freight terminal and so forth. Knowing this figure, you will also be able to determine whether

truck or team will prove more profitable on a given route. As between two trucks, you can determine which is operated more efficiently. You know the cost of delivering your merchandise and are in a position to make a proper charge for present deliveries and to figure future contracts without danger of loss. It is your standard of measurement, your unit of comparison, and having it, you can judge all other means of transportation by it, asking always the all-important question—"What will it cost me per ton-mile?"

It will help to show the relation between the three factors—cost, performance, and cost per ton-mile, if we repeat the chart shown in Figure 29, this time with the ton-mile column added.

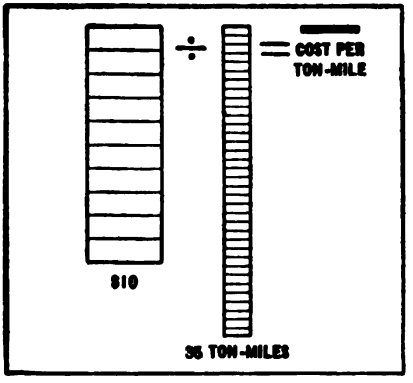


FIGURE 31

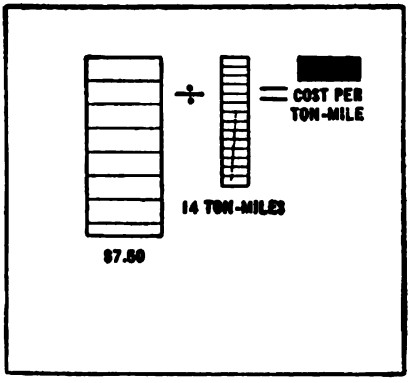


FIGURE 32

It will be seen that the chart proves out graphically as well as by figures, and that the longer the column which represents performance in comparison with the column representing cost, the shorter the final result, that is, the cost per ton-mile. Here in simple form is the philosophy of costs as applied to motor trucks. Keep it in mind, and you will not go far astray in calculating the expense of hauling your goods. (Figures 31 and 32.)

How to Figure the Ton-Mile. One thing remains to be explained more fully. What is the ton-mile and how is it figured? You have been shown where costs come from, but what are the items, and how they are assembled, which make up the column headed performance? How shall we measure the work which a motor truck does? For we must know the nature and the extent of this work, that is, the number of ton-miles, before we can divide and get the cost of one ton-mile.

It is obvious that the motor truck performs work because of its ability to haul a load at a certain rate of speed. In Chapter II we established the formula that speed multiplied by the load equals the work. Both factors are equally important. Thus, if two trucks have the same load-carrying capacity, but one travels twice as fast as the other, it is clear that the faster truck will deliver two loads while the slower truck is delivering one. Similarly, if both trucks have the same speed, but one is able to carry twice the load of the other, the stronger truck will deliver twice as much merchandise as the weaker one. Now instead of *speed* let us substitute the term *distance*, which we can safely do now that we have entered the field of accounting. DISTANCE × LOAD = WORK accomplished. Let us call distance: miles, and load, tons, and we have ton-miles. But you say, suppose a truck took a week to deliver one ton a distance of ten miles. In that case, all your truck expenses for the week would be charged against those ten ton-miles, making the cost per ton-mile something like five or six dollars. That is where your cost system comes in and shows you not only what work your truck is doing, but at what rate, also.

The ton-mile, then, is one ton carried one mile. One ton carried five miles equals five ton-miles. Similarly five tons carried one mile equals five ton-miles. Two tons carried six miles makes twelve ton-miles. A half ton carried three miles equals one and a half ton-miles. Ton-mileage is the product of tons carried, multiplied by distance hauled. It is used by railroads in reporting their yearly business of hauling freight. It may be employed to measure the work done by the motor truck.

Such a method of figuring, you will say, is simplicity itself, since it is merely necessary to multiply the weight of the load in tons by the distance it is hauled in order to arrive at a figure which will describe the work performed by the truck each day. While this kind of figuring is very satisfactory in railroad work, where tremendous loads are carried great distances intact and often delivered without reduction in weight, far different conditions are met in truck operation.

A Concrete Example. Consider the following case. A dry goods truck starts out with a capacity load of two tons. After traveling one mile it delivers a quarter ton. Half a mile farther on it delivers a bundle weighing one hundred pounds. For the next five miles it makes stops on the average of eight per

mile, delivering bundles and merchandise weighing from ten to two hundred pounds at a stop. It has made forty-odd stops in reducing its tonnage from the original two tons to zero. How shall we figure the ton-mileage of such a trip?

If we were to compute it strictly according to the standard ton-mile, we should have to make over forty separate calculations, for as the tonnage carried is constantly being reduced, the resultant ton-mileage for a given distance is becoming less and less. But before we go any further we throw up our hands at the impossibility of any such plan. It would be necessary to carry a bookkeeper along with the driver, and an adding machine as well, in order to keep up with such a system of accounting. Moreover, a little reflection will show that such a system is unfair from the point of view of costs, inasmuch as it is nearly as expensive to drive a truck whose load has been reduced by several deliveries as one loaded to capacity.

What is a Commercial Ton-Mile? Instead of the absolute ton-mile, the commercial ton-mile is generally used in computing motor truck performances. Here no notice is taken of the various partial deliveries of the truck's load, inasmuch as this will be reflected more or less faithfully in the item of distance covered. The commercial ton-mile is computed by multiplying the load with which the truck starts out by the round-trip distance. If any load is picked up along the route, such for instance as a return load, commercial ton-mileage is figured against it precisely as if the truck were starting out again, with what is really a pick-up considered as a new load for delivery.

As a matter of fact the absolute ton-mile is rarely suitable for commercial computation, and is only valuable in engineering or scientific work. It is useless for cost computations, for the reason that it gives no measure of useful work accomplished. In delivering a load of goods from one point to another and returning to the starting point for another load a truck is doing useful work every minute that the wheels turn. If you were to use the absolute ton-mile, it would appear that the truck was only working while it was carrying a load, and in figuring costs it would seem that there was a tremendous waste in having the truck return empty. Suppose, however, that your delivery problem is such that only a one-way load is possible, and that through no efforts in the way of replanning your delivery system can you alter the fundamental conditions of your installation. The

empty return of the truck is as necessary a part of the delivery as the loaded trip out. The cost system should reflect that fact.

The problem of figuring the ton-mile is so important, and so much difference of opinion exists concerning it that we present in Figure 33 a chart from the *Commercial Vehicle*, of New York, which originated the idea of the commercial ton-mile and has

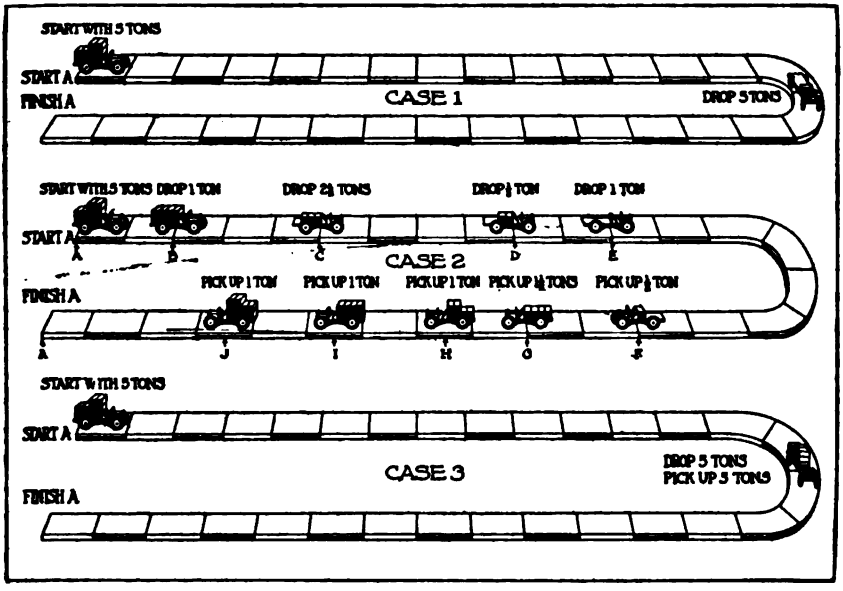


FIGURE 33: Figuring ton-mileage is more than merely multiplying tons hauled by miles covered. This chart shows three conditions of haulage which complicate the problem. One, two, or all of these conditions may obtain in your business.

incorporated it in its standard cost system. This cost system has been approved by the Federal Trade Commission and is described more fully in Chapter V.

Computing the Commercial Ton-Mileage. The three cases shown in the drawing above represent a motor truck traveling over the same route but under different conditions. Your motor trucks operate under conditions depicted by one of these three cases, or combinations of them.

Case No. 1. Shows a truck leaving with a full load, all of which it drops at the half-way point, returning empty.

Case No. 2. Shows a truck which drops its load by means of several deliveries, and on the return trip picks up portions of a load, returning to the store with a capacity cargo.

Case No. 3. Shows a truck which leaves with a full load, drops it entirely at one point and picks up a full load at the same point and returns with it.

How would you compute the commercial ton-mileage, according to the definition given on page 50, for these three trucks?

Case 1. $5 \times 30 = 150$ commercial ton-miles.
Case 2. $10 \times 30 = 300$ commercial ton-miles.
Case 3. $10 \times 30 = 300$ commercial ton-miles.

Most trucks are operated under conditions depicted in Case 2, that is, they are continually making deliveries of portions of their loads. To determine the absolute ton-miles in Case 2 would require ten separate multiplications, one for each stop at which a portion of the load was delivered. If there had been twenty stops instead of ten, twenty multiplications would have been necessary; if thirty stops, thirty multiplications, and so on indefinitely. But when the commercial ton-mile is used, only one multiplication is required.

Where the Information Comes From. Where does the information come from, which is used to figure the ton-mile? The answer is—the driver's card. In Figure 34 a sample card is reproduced which shows how the information necessary to figure the ton-mile is used.

Here you will observe we do not even know the mileage for each trip. If this were given we could compute the ton-mileage of each trip separately, and perhaps gain a little in accuracy. For all practical purposes, however, the same result can be had by assuming that all trips are the same in extent. This, of course is not true in fact, but when figured over the period of a month an average is obtained which reflects the true conditions.

So much, then, for the ton-mile, which is to transportation what the horse-power is to engines, the unit of measuring work. But what about those concerns which do not haul their merchandise in tons and consequently cannot use the ton or even the hundredweight or pound as units with which to measure their transportation?

There is the grocer, whose initial load sometimes does not amount to a ton, and who delivers his merchandise in baskets; the department store truck, which flits from house to house delivering packages whose weight may be reckoned in ounces, and the time of which is influenced more by the number of stops than by the tonnage handled. There is the brewer whose load is

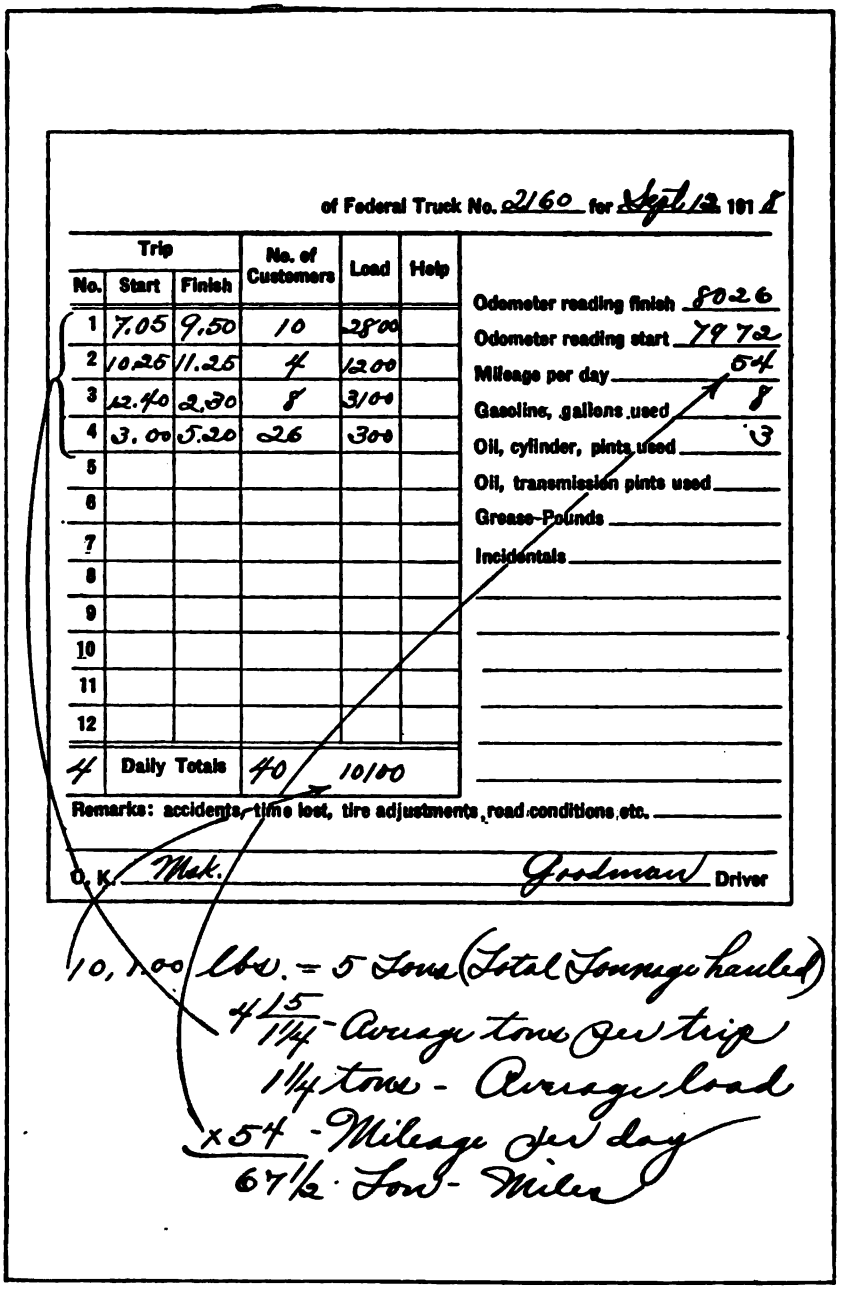

of Federal Truck No. 2160 for Sept 12 191 8
Trip
No. Start Finish
No. of Customers
Load
Help
1 7.05 9.50 10 2800
2 10.25 11.25 4 1200
3 12.40 2.30 8 3100
4 3.00 5.20 26 3000
4 Daily Totals 40 10100
Odometer reading finish 8026
Odometer reading start 7972
Mileage per day 54
Gasoline, gallons used 8
Oil, cylinder, pints used 3
Oil, transmission pints used
Grease-Pounds
Incidentals
Remarks: accidents, time lost, tire adjustments, road conditions, etc.
O. K. Mak.
Goodman Driver
10,100 lbs. = 5 Tons (Total Tonnage hauled)
4 15/17 - Average tons per trip
1 1/4 tons - Average load
x 54 - Mileage per day
67 1/2 Ton - Miles

FIGURE 34: This graphic chart shows clearly how to figure the ton-mileage. When your truck makes but one trip a day, multiply the mileage by the number of tons carried. When it makes more than one trip, the average ton per load must be ascertained first. Perhaps your driver would be interested in this formula.

reckoned in kegs, the lumberman who writes up his units in "M-feet," or the soda-pop dealer who delivers cases. How shall these truck owners compute the performance of their motor trucks?

Other Standards of Measurement. The answer is simple. In place of the ton measure, substitute whatever unit will best serve to measure the delivery of the merchandise. Thus, instead of the ton-mile, many operators prefer to figure the package-mile, multiplying the number of packages delivered by the mileage covered in delivering them, or the thousand-feet-mile, or the keg-mile, or the case-mile.

Again, some concerns eliminate the item of mileage altogether, figuring the number of stops, or the number of packages delivered. It is obvious, of course, that even though mileage is thus left out, the more efficient truck, the one which covers the greatest mileage will also show the largest number of stops made or packages delivered.

The problem is not complicated by the addition of these other units of performance. It is still merely a case of simple division—dividing the cost by the number of units performed gives the cost per unit. Thus, a well-informed truck operator is able to tell not only his cost per package-mile, but often as well, his cost per stop, per package, per mile, per hour, per trip, or per anything which is of value to him.

CHAPTER V

HOW TO KEEP AN EFFECTIVE RECORD OF COSTS

WHEN the Honorable Edward N. Hurley was chairman of the Federal Trade Commission he won great admiration from thoughtful business men throughout the United States because of his keen insight into practical business problems and his constant and sympathetic endeavors to place manufacturing and selling in this country on a more sound and profitable basis. One of his principal endeavors was to bring the business interests of the country to a clearer realization of the advantages to be gained from knowing accurately what it costs to manufacture and sell their products. With this end in view The Federal Trade Commission, under his direction, devised a system of accounts for manufacturers and retail merchants, both of which have proved of great value.

The Federal Trade Commission on "Cost Accounting." The following quotations, taken from an official bulletin describing these systems, are so forceful, and so applicable to the problem of motor delivery, whether considered as a business in itself, or as an adjunct to some other business, that they will convince truck owners of the need for keeping track of their delivery costs:

"More and more concerns are joining the ranks of those who realize the necessity of knowing accurately their costs of manufacturing and selling. This bulletin has been prepared with a view to aiding the campaign of education by explaining what a cost system is, how it operates, the results obtained, and the benefits to be derived from its operation.

"The prime object of a cost system is to determine costs, to analyze and compare them, and to use them as a basis for making prices. Formerly the necessity for the determination of true manufacturing costs was not as imperative as it is today. Margins between cost and selling price in most lines were larger. Costs could be ignored except in a general way and a good return would be made on the investment; but today margins of profit in most lines of

trade are very much narrower than formerly, and the necessity for the most efficient management and closest analysis is felt as never before.

"The only reliable way by which an executive can judge the efficiency of an organization is through a system of periodical statistical reports. These reports can only be accurately obtained when a good cost system is in operation.

"But the uses and advantages go further. A manufacturer (or merchant), from reliable records is able to make clearer and more intelligent statements to his bank and thereby obtain a larger line of credit than he could without them.

"Banks are paying more and more attention to the accounting methods used by the merchant to whom they extend credit. They are willing to give larger loans and very often more liberal terms to the merchant who keeps his books in a way that enables him to show the bank at any time just how his business is progressing. A merchant who can show progress will undoubtedly receive more consideration with the same amount of assets than one who can not. Even if he is successful but cannot show it because of his bookkeeping methods the bank will not consider him a desirable credit risk. Another very important point to which the bank gives consideration is whether the prospective borrower is making proper provisions for depreciation on stock, buildings, and fixtures, and his books should be so arranged as to show the amount of these provisions. No merchant can be said to be managing his business properly unless adequate provision is made for depreciation.

"There are a number of objections in the minds of business men who have not installed cost systems, to taking up the matter. One of these is the feeling that exists in the minds of so many that their business is unique and different from any other and that no system could be devised which would give them true costs. It is unquestionably true that some lines . . . lend themselves more readily to the installation of a cost system than others, but it is also true that no line . . . is so complicated that a system cannot be devised which will give reasonably accurate results.

"A system will not run itself; neither will it in itself reduce costs, nor increase efficiency. This is strictly up to the manufacturer (or merchant) himself. A system will give him the information, and if this information is properly used, he will unquestionably find that his system is not an item of expense (nor an unnecessary amount of red tape) but a very valuable asset.

"The Federal Trade Commission is urging manufacturers to give the subject of accurate costs the attention it deserves. It has found that unreliable costs of production and distribution cause a great deal of unfair competition and a heavy business death rate.

"While the claim is not made that a cost system will save a man from failure the claim is made that a man who knows where he stands day by day is very much less likely to make a failure of his business than one who is directing his business by guesswork."

How many truck owners maintain an accounting system covering the operation of their trucks? The number is small, surprisingly small when you consider what a great deal of information can be gained from even a simple system of accounts.

A system comprising only two forms, and requiring but a few minutes a day per truck to keep going, will tell the truck owner dozens of facts about his truck: whether it is being operated efficiently or not and why; what leaks are reducing his profits and where; what means should be employed to speed up his delivery system, and how they should be put into effect.

Analyzing a Cost Record. Here are some of the facts which the truck owner wants to know about his installation, facts which a simple cost record will tell him:

How much does it cost to deliver a package?
Which make of tire gives the most mileage?
Which driver is the most efficient?
Which truck shows the least cost for repairs?
Which route is the most profitable?
Which route shows the most standing time?
Which truck uses the most fuel in proportion to mileage?
Which truck covers the most mileage in a day, month, or year?
Which truck delivers the largest ton-mileage?
How much time did a certain driver work on a certain job?
What spare parts were ordered and at what cost?
What is the cost of truck operation for a day?
What is the cost of truck operation for a mile?
What is the cost of truck operation for a month?
What is the garage costing?
How does fuel used check up with mileage run?
What is the tendency to overload and overspeed?
What is the relative efficiency of certain trucks for certain kinds of work?
What is the comparative record as between any two trucks of:

Trips per day	Days in service
Customers per day	Days out of service
Miles per day	Repair costs per mile

All the facts are pertinent to the costs and performance of your motor truck. They point like fingers to the weak spots in your truck installation. By comparison they show what is good and what is faulty in your system of truck operation. And once the faults are pointed out it does not take you long to correct them.

How a Cost System Works. A simple but complete cost system can be put into effect by the use of only two forms. The first form is the driver's daily card, and the second the

monthly summary. These two forms are absolutely essential, but on the other hand additional forms are often used in connection with them, such as tire record forms, gasoline tickets, and so on. Such forms, however, are merely supplementary, and are designed to give more detailed information on one or more items already included in the driver's card or the monthly summary.

It will help us to understand the use of these forms if we present once more the various items of cost and performance and ask ourselves how the information is obtained.

Figuring Fixed Expenses. Interest is known to a penny and never changes. Insurance is also a fixed figure, and the item of taxes and license is known at least for a year. The item of garage cost is a fixed amount provided the garage is rented; if the owner maintains his own garage this is the subject of a separate account and its total or final cost is supplied for the purpose of entering it on the motor truck account. Depreciation, if figured at 20% a year, is a fixed amount, but it is perhaps more nearly accurate to compute it according to mileage run, in which case more information is necessary. (Figure 35.)

Maintenance, which includes both overhauling and general repairs, is computed from bills rendered by the garage or the manufacturer. The cost of tires must remain a blank until the daily or monthly mileage is learned, since tire costs are figured on a basis of 7,000 miles inasmuch as that is also the prevailing standard basis of adjustment by the tire companies. Wages is a known item, unless it is the practice of the truck owner to shift the driver from job to job, as, for instance when the truck is idle for two or three hours. In that case we must have further information regarding the length of time the truck was in service. Supervision is an item the size of which may be determined in advance and may be regarded as a known and fixed amount.

Determining Variable Expenses. We now come to a series of items of both cost and performance which are either not fixed and known in advance, or which will not come to the attention of the truck operator unless some special provision is made for that purpose. These items represent, first, the supplies which are dealt out to the truck to enable it to perform its daily work, and second, the daily work itself in terms of load carried and distance traveled. These items are furnished by the driver's daily report card.

In Figure 36 we have taken a daily report record filled out by the driver of a 4-ton truck, and have applied it against Figure 35. How the information on the card filled out by the driver is used by the truck owner in completing his row of cost and performance items can be seen at a glance.

What a Driver's Card Should Show. While the driver's card which we have shown on page 61 is designed to take care of the needs of many different lines of business, it must not be supposed that there is any single or standard form which is suitable for all conditions. Various concerns often work out their own design for such a card, adapting it to the peculiar circumstances of their hauling problem, or perhaps fitting it to their accounting system which, by reason of special forms may require special information on the daily report.

In general, however, it is agreed that the driver's daily report card should embody the following features:

(1) It should be made of tough manila cardboard, so that it will not suffer from rough or careless handling.

(2) It should be punched with a hole reenforced like a tag so that it can be tied on to the steering wheel or other part of the truck—or

(3) It should be made small enough to fit into the driver's pocket or hat.

(4) It should be as simple as possible consistent with furnishing the information actually required by the business.

(5) It may be combined with an inspection report (generally on the back).

(6) It should give at least the following information:

a. Identification
b. Supplies
c. Trips
d. Tonnage or packages
e. Miles
f. Time
g. Weather conditions

On pages 62 and 63 are reproductions of several driver's cards, used successfully in different lines of business, and ranging all the way from the comparatively simple card to the more complicated and complete. Here you will probably find one or two forms specially suitable for your business. It may be that your trucks make thirty or forty trips per day, in which case the ordinary card with its provision for seven or eight trips would not suffice. You may not be interested in analyzing each trip but will be satisfied with knowing merely the total trips per day. No. 10 is designed to supply that information. Or again, it is possible that you may let out one or more trucks for hire, in which case each separate trip must be carefully recorded and

analyzed, so that a proper charge can be made to the customer. No. 5 shows a card used by one of the largest motor haulage companies in Chicago to provide this information. No. 3 is adapted to the transfer business. No. 7 was used by a large coal company. No. 6 has been successfully used by meat packers.

Making Up the Monthly Summary. Let us now consider the second part of a simple "two part" accounting system—the monthly summary. In Figure 36 is presented a chart showing all the items of cost and performance in a simple system which the truck owner must know before he can calculate the cost of the truck in relation to the work performed. We showed that the information covering these items came from various sources, some of it from garage bills, repair bills, and other bills, some of it from the company's books in the shape of a fixed and never-changing charge, and some of it from the driver's daily report cards.

Let us imagine the truck operator shortly after the end of the month calculating his expenses for the previous month. On the desk in front of him are bills and vouchers. Memorandums from the bookkeeper inform him of charges for interest, taxes and so forth. Stacked high is a pile of driver's daily cards, twenty-five in number. Here is all the material necessary for computing his truck expense for the month. He reaches for a sheet of paper, a long sheet if he can find it, heads it with the name of the month, the identification of the truck, the name of the driver, and so forth. Then he proceeds to put down as headings the very items with which you are now familiar.

He takes the driver's cards, twenty-five in number, and casts up a total of gasoline used, miles traveled, tons hauled and so on, for the month. He computes his estimated tire expense for the month, puts down his driver's wages, helper's wages, interest, taxes, and depreciation, and all the other expenses which properly may be charged against his motor installation. He has, in fact, made out a monthly summary.

Computing Final Costs. He has now put down in simple and summary form all the facts necessary to know in order to compute to a penny the expense of his motor installation. No essential has been left out. Let us review in graphic form the evolution of this simple system. In Figure 38 we present once more the familiar row of items which constitute cost and performance. Where these items come from is shown by the lines

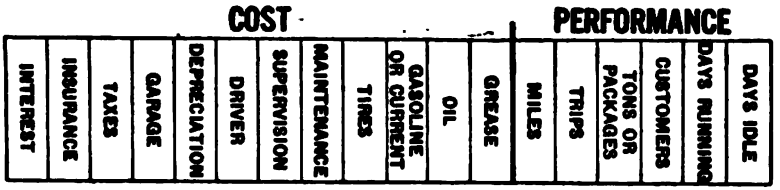
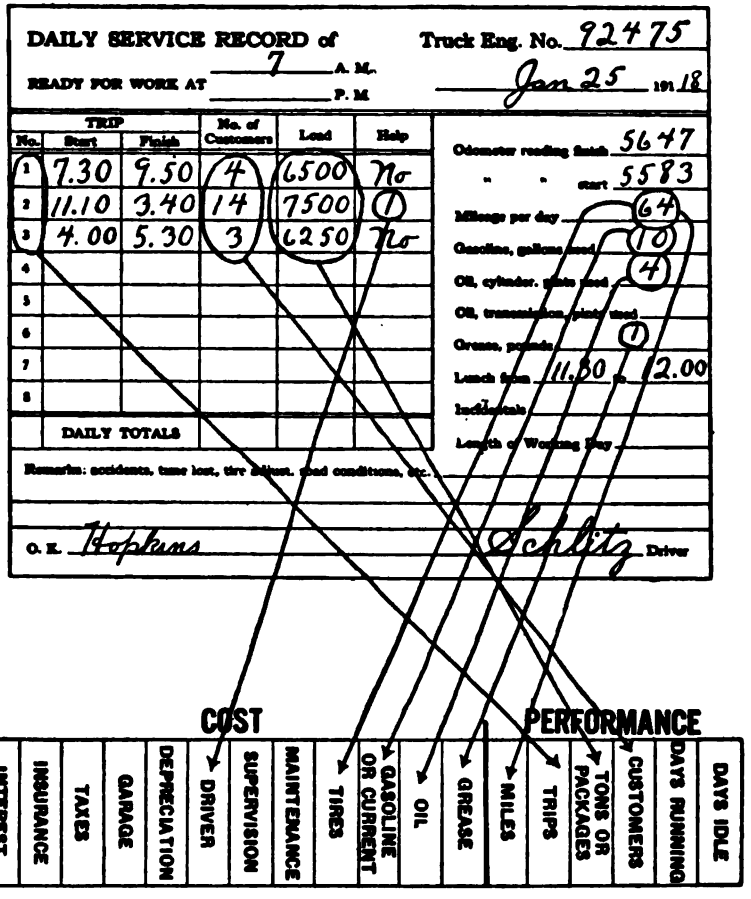


FIGURE 35: Certain cost items are known to a penny. Among them are interest and taxes. Garage cost is a fixed charge if the garage is rented. If not, it requires a separate account. These figures will help to determine costs.



FIGURES 35 and 36: Certain items of cost are arrived at automatically—from bills, fixed charges, and the like. Other items you must "go out after." A daily report card such as the above will help you, for it provides all the information necessary to compute accurately the operating expenses of your truck for any period of time.

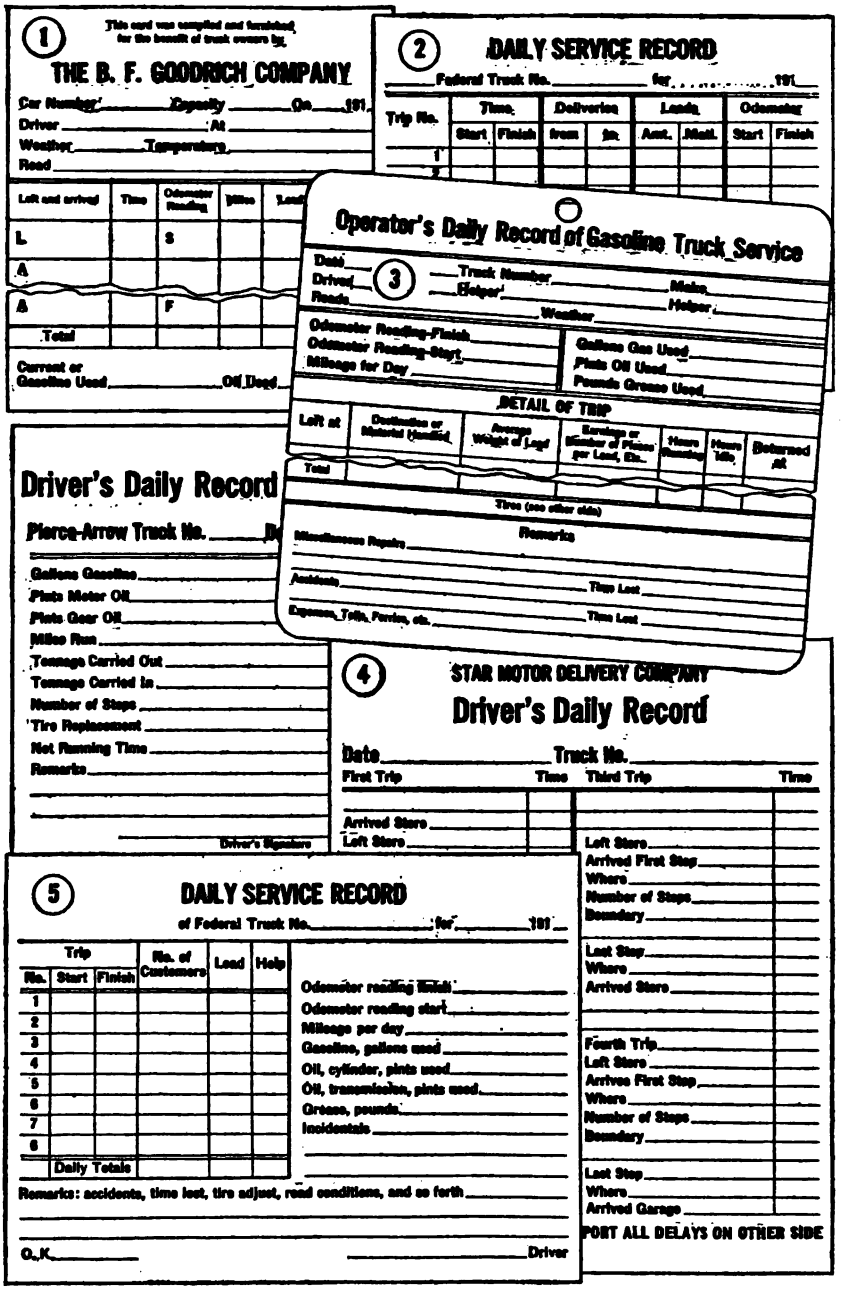
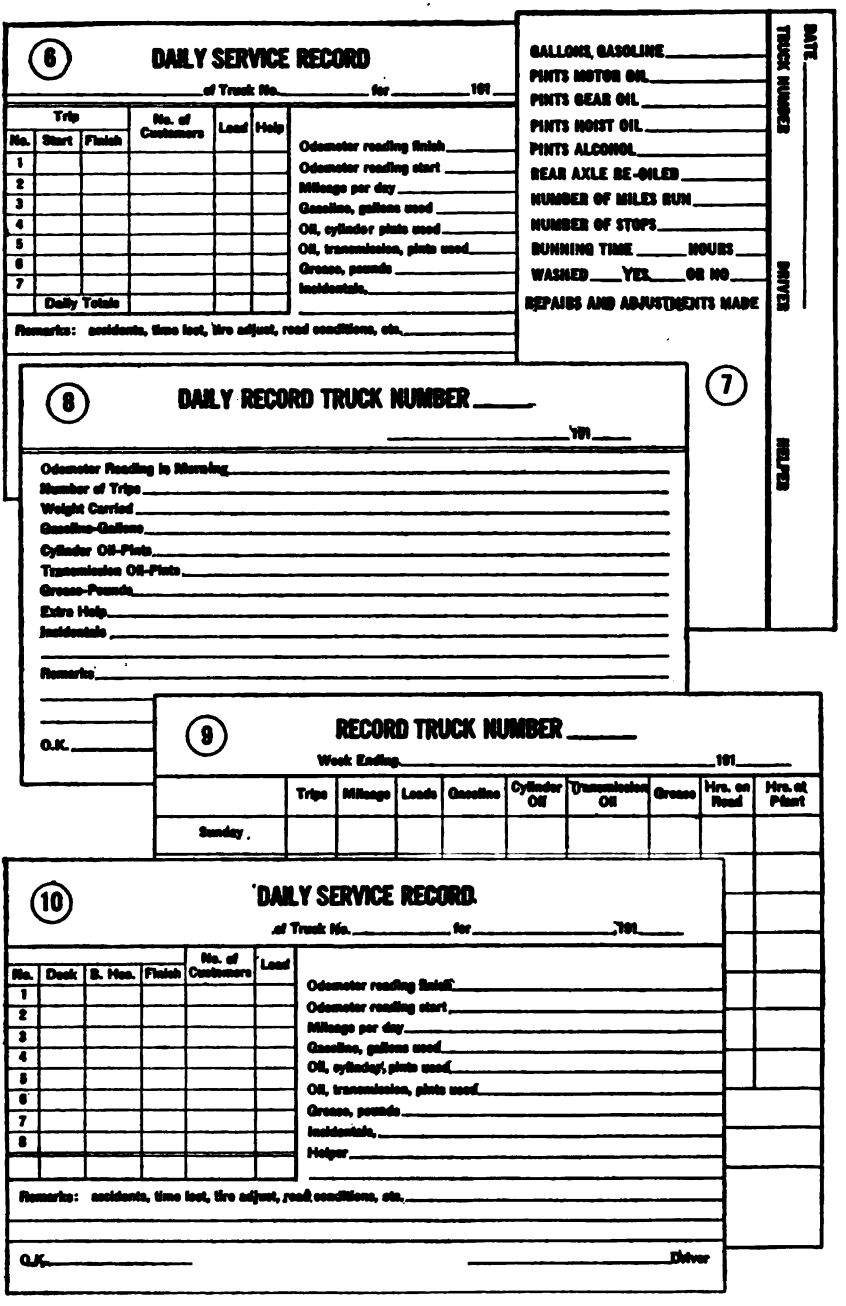


FIGURE 37: Each of the eleven drivers' cards shown on this and the opposite page is in daily use. Your business may require additional information but that is simply a matter of selecting the one best suited to your needs and making such additions as will meet the special requirements of your business.



6 DAILY SERVICE RECORD

of Truck No. for 191

No.	Trip Start	Trip Finish	No. of Customers	Load	Help
1					
2					
3					
4					
5					
6					
7					
	Daily Totals				

Odometer reading finish
Odometer reading start
Mileage per day
Gasoline, gallons used
Oil, cylinder plate used
Oil, transmission, plate used
Grease, pounds
Incidentals
Helper

Remarks: accidents, time lost, tire adjust, road conditions, etc.

GALLONS, GASOLINE
PINTS MOTOR OIL
PINTS GEAR OIL
PINTS HOIST OIL
PINTS ALCOHOL
REAR AXLE RE-OILED
NUMBER OF MILES RUN
NUMBER OF STOPS
RUNNING TIME HOURS
WASHED YES OR NO
REPAIRS AND ADJUSTMENTS MADE

DATE
TRUCK NUMBER
DRIVER
HELPER

7

8 DAILY RECORD TRUCK NUMBER

191

Odometer Reading in Morning
Number of Trips
Weight Carried
Gasoline-Gallons
Cylinder Oil-Plate
Transmission Oil-Plate
Grease-Pounds
Extra Help
Incidentals
Remarks
O.K.

9 RECORD TRUCK NUMBER

Week Ending 191

	Trips	Mileage	Loads	Gasoline	Cylinder Oil	Transmission Oil	Grease	Hrs. on Road	Hrs. at Plant
Sunday									

10 DAILY SERVICE RECORD

of Truck No. for 191

No.	Dock	B. Hse.	Finish	No. of Customers	Load
1					
2					
3					
4					
5					
6					
7					
8					

Odometer reading finish
Odometer reading start
Mileage per day
Gasoline, gallons used
Oil, cylinder, plate used
Oil, transmission, plate used
Grease, pounds
Incidentals
Helper

Remarks: accidents, time lost, tire adjust, road conditions, etc.

O.K. Driver

FIGURE 37: Your business would indeed be peculiar if you couldn't find among the drivers' cards reproduced on this and the opposite page, one that will meet your requirements. All of them have been in actual use and have been selected from among a hundred or more gathered during the preparation of this book.

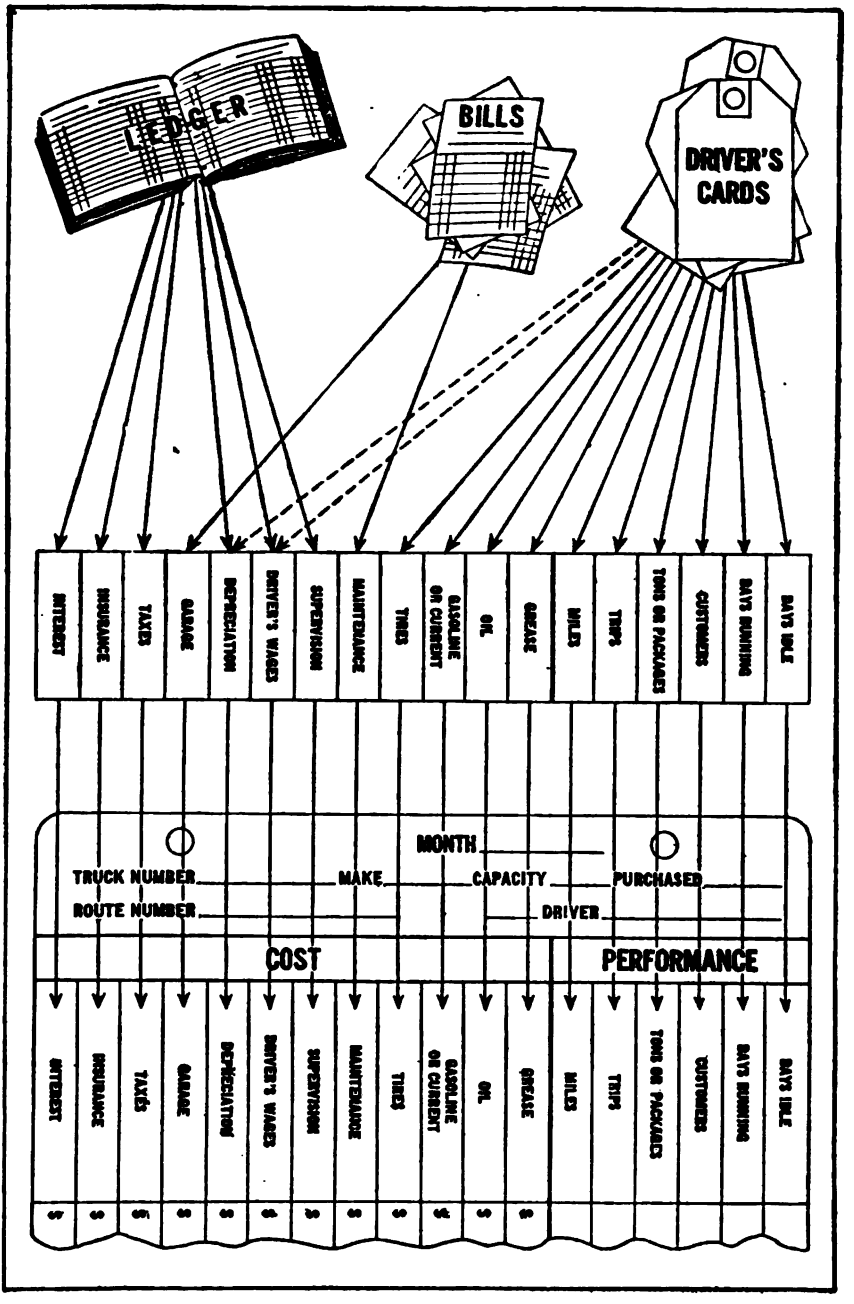


FIGURE 38: There is no mystery in keeping track of truck operating costs. Certain items of cost and performance must be had. The ledger, the invoices, and the drivers' cards each yield information on these different items. Then the amounts must be entered on a form conveniently ruled to take care of them.

running from the driver's cards, the various invoices, and the firm's ledger. The monthly summary is nothing but a reproduction of the row of items, with the addition of ruled lines.

These are the essentials of a simple system embodying a driver's card and a monthly summary. Nothing has been left out which is necessary to give a true picture of costs and performance. On the other hand, nothing has been treated in detail. Let us follow the thought of the merchant now, who has jotted down the essential items on this simple form.

Emphasizing Special Features. For instance, the cost of gasoline for the month was $90; the mileage was 1,500. It is apparent that if you divide 90 by 1,500 you will get an interesting and useful figure, namely, the cost of gasoline per mile, which in this case is 6 cents. Obviously it is advisable to provide a special space for recording this fact. In the same way the total cost per month can be divided by the number of miles run per month, giving the cost per mile. In a similar manner the cost per day, or per hour, or per ton, or per ton-mile can be computed. These computations must be provided for by the addition of ruled lines and spaces, so that the complete monthly summary sheet (Figure 40) is a more complicated sheet than the simple one shown on page 64. Observe, however, that these additions do not indicate that any new facts have been added, but merely that the facts already given (as on the simple sheet) have been compared one with another, and valuable results have been disclosed, such as the proportion which one or more items of expense bear to one or more items of performance.

Itemizing the Expenses. The monthly summary given in Figure 40 shows very clearly how such a record can be made fairly to speak out concerning the operation of a certain truck. Observe here how the record treats the item of maintenance. It is split up into five sections, enabling the owner to tell each month, not only the cost of repairs, but how much of the total cost of repairs should be charged against the motor, how much against the axles, the chassis, and the body. This could be extended to specify such items as transmission, differential, wheels, and so forth, or it could be contracted by considering the body with the chassis, and the axles with the motor.

Such records can be put to most profitable use in comparing the cost and performance of one truck with another. This is the way to find out which truck uses the most gasoline per mile, which

driver is most efficient, which route is most effectively planned, which deliveries most economical. The facts of cost and performance taken from the monthly summary should be selected and drawn up in parallel columns, one column for each truck. (See Figure 39.) In a similar way, the performance of the same truck from month to month may be checked, leaks discovered and any tendency of the driver to become careless may be caught and arrested in time.

A Practical Cost System. "What cost system will be best for my business?" That is a question which thousands of truck owners have asked and tried to answer. As a result scores of accounting forms have been devised, each differing in some minor respect from the other. In the following pages of this chapter we present two systems, either of which may be applied to motor truck installations with an average hauling problem.

The first and more simple of the two was devised by the *Commercial Vehicle Magazine*, to whose publishers we are indebted for permission to reproduce it in this volume. They spent two years planning it, in the course of which they examined hundreds of individual records. The Federal Trade Commission has given official indorsement to it. The system employs two forms: First the driver's card, which shows on its face (Figure 41) performance and supply items; and on its reverse side (Figure 42) a mechanical report. Figures 43 and 44 show the monthly summary.

How the System Works. In explaining the system an imaginary installation is used, in order to bring out all possible points. The hypothetical installation is that of the Omega Department Store, the truck selected being an Ajax 1½-ton delivery truck, used in package delivery. The truck is garaged in the concern's own garage and is used for delivery of packages in a residential district and for occasional runs to the warehouse to transfer goods to the main store. The truck covers two routes. The garage is three miles from the store and one mile from the warehouse which is two miles from the store.

The truck is a gasoline one, equipped with pneumatic tires, 36 by 4, six in all, the rear ones being dual. These tires cost $30 apiece and are guaranteed for 3,500 miles. Thus the value of the tires when the truck was bought was $180. The truck cost $1,500, the body $850, and the equipment, including a speedometer, horn, and and such other accesories as were installed, totaled $37.50. Supplies cost as follows:

Gasoline, 32 cents per gallon
Lubricating oil, 80 cents per gallon, or 20 cents per quart
Grease, 25 cents per pound
Kerosene, 12 cents per gallon
Waste, 18 cents per pound
The driver is paid $2.75 per day, Saturdays included, and 30 cents per hour for time in excess of 9 hours per day.

There are two helpers, Joe, who gets $2 a day, and Will, who gets $1.50. Joe spends his full time on the truck and is not paid overtime. He is picked up at the store and leaves the truck there at night. Will only spends part of his time on the truck, that is, when the loads are big, and only such of his time as is spent on the truck is charged to the truck, the rest of his time being spent in the shipping room. Garage mechanics are paid 40 cents per hour. Each truck is charged for the actual time a mechanic spends on the truck, the balance being charged to garage overhead, which is lumped with other garage expenses and rental of the garage and apportioned at $62.50 per month for each truck. The washer is paid $1.50 per day, his time being taken up with janitor work at the garage besides washing and polishing. The rest of his time is charged to garage overhead.

The truck is overhauled once a year at the Ajax service station at an average cost of $100. Painting and relettering costs $17.50 per year. Spare vehicles are rented from a haulage contractor at $10 a day. A combination insurance policy costs $57.95 per year. Interest is computed at 6% on the investment. Depreciation is taken at 20% on the chassis, body and equipment, but not on the tires. Taxes and licenses total $21 per year. As all the costs of the store are computed on a basis of packages, the commercial package-mile is the basis for truck costs.

Putting the System into Operation. The delivery superintendent of the store keeps the costs of the trucks and personally supervises the work of the garage. The driver's cards are given them each night when they return to the garage in exchange for filled-out ones. These cards are hung on small brass hooks affixed to the side of the cab top, at the side of the driver. Each morning when the driver of the Ajax truck leaves the garage, he fills in his card with the truck number—25—his name, the date, and has the garage manager fill in the time of departure.

Arriving at the store, his helper meets him with his route hamper loaded with packages and gives him the shipping clerk's instructions. The packages are loaded into the truck and from

his route sheet the driver notes the number of packages to be delivered, the number picked up and the number to be returned to the store, in their proper columns, as shown in the figure. On his return to the store he notes the mileage, which includes the three miles from the garage to the store and that of the first trip. Subsequent trips are similarly checked until the end of the day when he returns to the garage.

The Mechanical Report. Before putting up the truck for the night, the driver carefully checks over the list of parts on the reverse side of his card (Figure 42), placing a checkmark opposite all parts which, in his judgment, are performing properly. If, for example, he finds that his engine has been overheated several times during the day, he will place a letter "A" in the space opposite "cooling," or if his fan belt breaks he will place a letter "R" opposite "fan belt" in the second column. If there are any other points which have given trouble and which are not on the list, he will write their names and the proper notation on one or more of the blank lines left at the bottom. On his return to the garage, he notes the mileage of the last trip and has the garage manager fill in the time of his return. He then hangs the card on the hook and is through for the day.

When the garage attendants are ready to fill the tanks and clean and polish the truck, the gallons of gasoline put in the tank are noted on the card and also the quarts of oil. If any kerosene is used to fill the lamps or for other purposes, the amount used is marked on the card, as well as grease and waste. The washer inserts the time spent on the truck in the proper blank and the card is turned over to the garage manager by the driver the following morning.

When the garage mechanic makes his rounds of inspection in the evening, he takes down the card and reads the driver's mechanical report. If he finds nothing but checkmarks, he is content with a brief inspection of the truck. If any parts are unchecked, he reports the matter either to the garage manager or the driver, and the latter is admonished that he must check all parts.

If an "A" appears opposite any part, he proceeds at once to inspect it carefully and to put it in proper shape, if possible. If not, he makes a notation to that effect and resumes work at the first opportunity. The same applies to an "R." If, in his subsequent inspection, he finds some part out of order, but

checked as O. K., he places a mark of his own opposite it and calls it to the attention of either the garage manager or the driver. When he has finished with the truck, he signs the card.

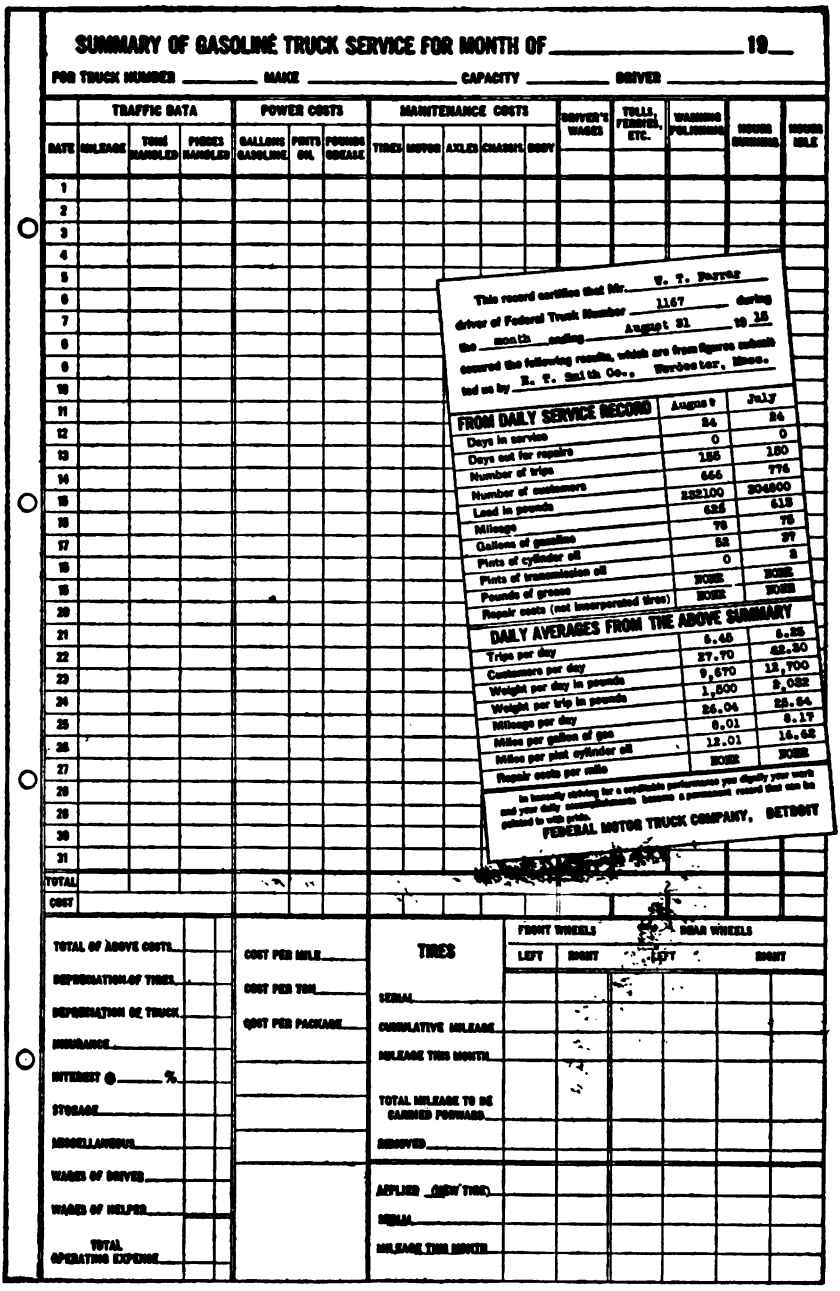
What Becomes of the Card. When the garage manager receives the filled-out card in the morning, giving the driver a new one in exchange, he goes over it, makes any corrections that are necessary, and turns it over to the timekeeper. The timekeeper notes the time of the driver and, from the shipping room reports, he gets the time of the helper and marks the time of each on the card. The card is then sent to the office of the delivery superintendent. At the end of the month the delivery superintendent takes the complete sets of cards for each truck and calculates the totals.

The first operation is to check the packages handled, then the total of packages delivered and packages returned, or else of packages sent out and picked up. When the total has been derived it is entered in Figure 44 as Item 8.

He then totals the mileage from the cards and enters it under Item 6. He counts the trips and enters their number under Item 7. Under Item 2 he places a number corresponding to the number of cards for that month; under Item 4, the calendar days of the month, and under Item 3, the difference between the two. The driver's time and the hours the truck was operated usually correspond, but in instances when a spare driver is employed his time is added to that of the regular driver in deriving the total hours operated, Item 5.

The gallons of gasoline, quarts of oil, pounds of waste and grease, and so on, are taken directly from the cards and entered in their proper places on Figure 43. The days or hours credited to the driver, helpers, washer and mechanic are similarly totaled from the cards and entered in Figure 43. As the driver's day is nine hours and as he is paid by the day, besides 30 cents per hour for overtime, hours in excess of nine are totaled and entered under the head inscribed "driver's overtime."

Data From the Ledger. From a memorandum, or the ledger, the delivery superintendent notes the prices for the supplies and rates of pay opposite these figures and then he computes the cost of each item. From the mileage figures, Item 6 (Figure 44), he secures the mileage entry for "tires" (Figure 43). By dividing $180 by 3,500 he secures the figure 5.143 cents per mile, tire cost. Multiplying this by the mileage figure, 1,805,



SUMMARY OF GASOLINE TRUCK SERVICE FOR MONTH OF _____ 19__

FOR TRUCK NUMBER _____ MAKE _____ CAPACITY _____ DRIVER _____

DATE	TRAFFIC DATA: MILEAGE	TONS HANDLED	PIECES HANDLED	POWER COSTS: GALLONS GASOLINE	PINTS OIL	POUNDS GREASE	MAINTENANCE COSTS: TIRES	MOTOR	AXLES	CHASSIS	BODY	DRIVER'S WAGES	TOLLS, FERRIES, ETC.	WASHING POLISHING	HOURS RUNNING	HOURS IDLE
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
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21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
31																
TOTAL																
COST																

This record certifies that Mr. W. T. Barnes driver of Federal Truck Number 1167 during the month ending August 31 19 18 secured the following results, which are from figures submitted to us by R. T. Smith Co., Worcester, Mass.

FROM DAILY SERVICE RECORD	August	July
Days in service	24	24
Days out for repairs	0	0
Number of trips	186	180
Number of customers	644	776
Load in pounds	232100	304800
Mileage	625	615
Gallons of gasoline	78	75
Pints of cylinder oil	58	27
Pints of transmission oil	0	2
Pounds of grease	NONE	NONE
Repair costs (not incorporated tires)	NONE	NONE
DAILY AVERAGES FROM THE ABOVE SUMMARY		
Trips per day	6.46	6.25
Customers per day	27.70	32.30
Weight per day in pounds	9,670	12,700
Weight per trip in pounds	1,500	2,032
Mileage per day	26.04	25.64
Miles per gallon of gas	8.01	8.17
Miles per pint cylinder oil	12.01	14.62
Repair costs per mile	NONE	NONE

In locally striving for a creditable performance you dignify your work and your daily accomplishments become a permanent record that can be added to with pride.

FEDERAL MOTOR TRUCK COMPANY, DETROIT

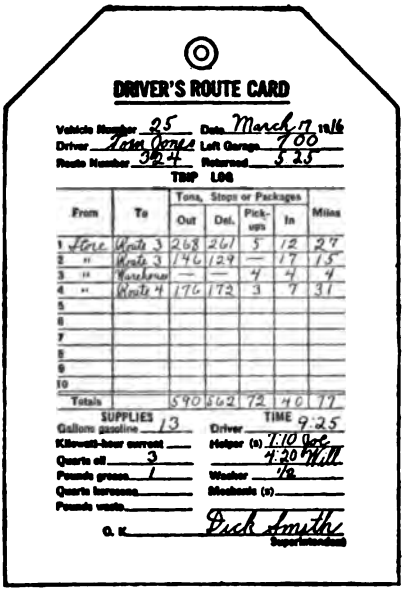
TOTAL OF ABOVE COSTS
DEPRECIATION OF TIRES
DEPRECIATION OF TRUCK
INSURANCE
INTEREST @ _____ %
STORAGE
MISCELLANEOUS
WAGES OF DRIVER
WAGES OF HELPER
TOTAL OPERATING EXPENSE

COST PER MILE
COST PER TON
COST PER PACKAGE

TIRES	FRONT WHEELS: LEFT	FRONT WHEELS: RIGHT	REAR WHEELS: LEFT	REAR WHEELS: RIGHT		
SERIAL						
CUMULATIVE MILEAGE						
MILEAGE THIS MONTH						
TOTAL MILEAGE TO BE CARRIED FORWARD						
REMOVED						
APPLIED (NEW TIRE)						
SERIAL						
MILEAGE THIS MONTH						

FIGURES 39 and 40: The small card is a special form (Figure 39) designed to show comparison of the performance record of the same truck in two months. It could be used to compare the records of the two trucks during the same month.

The large form (Figure 40) is a monthly summary of cost and performance.



DRIVER'S ROUTE CARD

Vehicle Number 25 Date March 17 1916
Driver Tom Jones Left Garage 7 00
Route Number 324 Returned 5 25

TRIP LOG

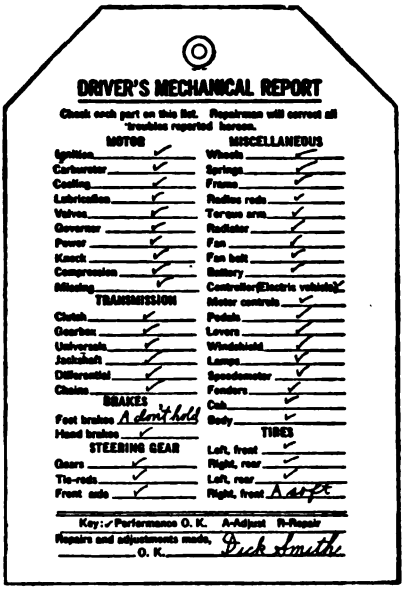
	From	To	Tons, Stops or Packages Out	Del.	Pick-ups	In	Miles
1	Store	Route 3	268	261	5	12	27
2	"	Route 3	146	129	—	17	15
3	"	Warehouse	—	—	4	4	4
4	"	Route 4	176	172	3	7	31
5							
6							
7							
8							
9							
10							
Totals			590	562	12	40	77

SUPPLIES
Gallons gasoline 13
Kilowatt-hour current —
Quarts oil 3
Pounds grease 1
Quarts kerosene —
Pounds waste —

TIME 9.25
Driver
Helper (s) 7.10 Joe
4.30 Will
Washer 1/2
Mechanic (s) —

O. K. Dick Smith
Superintendent

FIGURE 41: This driver's card furnishes complete information regarding the work performed and supplies used.



DRIVER'S MECHANICAL REPORT

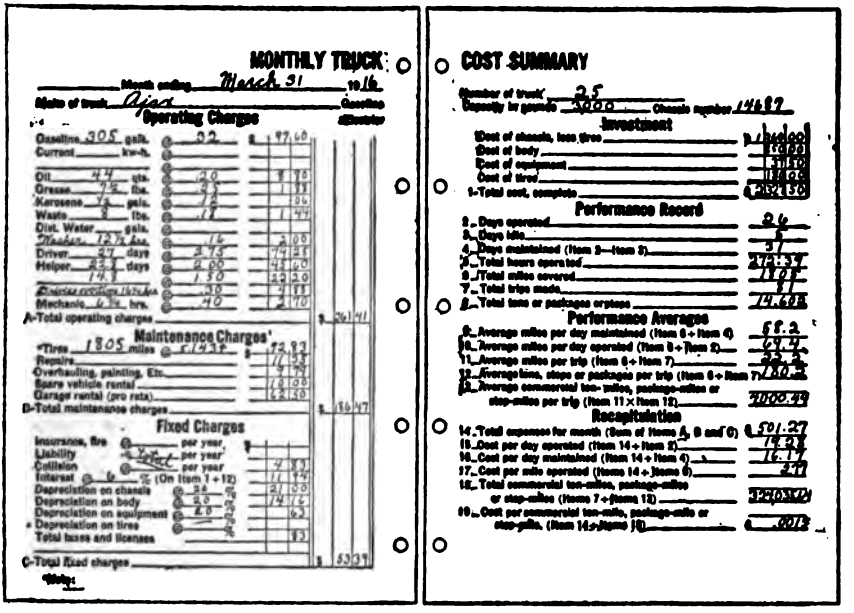
Check each part on this list. Repairman will correct all troubles reported hereon.

MOTOR		MISCELLANEOUS	
Ignition	✓	Wheels	✓
Carburetor	✓	Springs	✓
Cooling	✓	Frame	✓
Lubrication	✓	Radius rods	✓
Valves	✓	Torque arm	✓
Governor	✓	Radiator	✓
Power	✓	Fan	✓
Knock	✓	Fan belt	✓
Compression	✓	Battery	✓
Missing	✓	Controller (Electric vehicle)	✓
TRANSMISSION		Motor controls	✓
Clutch	✓	Pedals	✓
Gearbox	✓	Levers	✓
Universals	✓	Windshield	✓
Jackshaft	✓	Lamps	✓
Differential	✓	Speedometer	✓
Chains	✓	Fenders	✓
BRAKES		Cab	✓
Foot brakes	A don't hold	Body	✓
Hand brakes	✓	**TIRES**	
STEERING GEAR		Left, front	✓
Gears	✓	Right, rear	✓
Tie-rods	✓	Left, rear	✓
Front axle	✓	Right, front	A scrpe

Key: ✓ Performance O. K. A-Adjust R-Repair

Repairs and adjustments made,
O. K. Dick Smith

FIGURE 42: This form is the reverse of Figure 41. It provides for a report of the mechanical condition of the truck.



MONTHLY TRUCK

Month ending March 31 1916
Make of truck Ajax Gasoline Electric

Operating Charges

Gasoline 305 gals.	@ .02	$ 97.60	
Current kw-h.	@		
Oil 44 qts.	@ .20	8.80	
Grease 75 lbs.	@ .05	3.75	
Kerosene 7½ gals.	@ .12	.84	
Waste 8 lbs.	@ .18	1.44	
Dist. Water gals.	@		
Washer 12½ hrs.	@ .16	2.00	
Driver 27 days	@ 3.75	101.25	
Helper 27 days	@ 2.00	54.00	
13.5	@ 1.80	24.30	
Exercise cutting thistles	@ .30	4.05	
Mechanic 6½ hrs.	@ .40	2.70	
A-Total operating charges		$ 261.41	

Maintenance Charges

*Tires 1805 miles	@ 5.45¢	$ 98.32	
Repairs		17.53	
Overhauling, painting, Etc.		4.76	
Spare vehicle rental		10.00	
Garage rental (pro rata)		6.25	
B-Total maintenance charges		$ 136.47	

Fixed Charges

Insurance, fire	@ ____ per year,	$	
Liability	@ Collect per year		
Collision	@ per year	9.83	
Interest @ 6 %	(On Item 1 + 12)	11.42	
Depreciation on chassis	@ 25 %	31.00	
Depreciation on body	@ 20 %	14.16	
Depreciation on equipment	@ 5 %	6.3	
Depreciation on tires	@ — %		
Total taxes and licenses	— %	8.3	
C-Total fixed charges		$ 83.39	

Note: *Size

COST SUMMARY

Number of truck 25
Capacity in pounds 4000 Chassis number 14682

Investment

Cost of chassis, less tires	$ 1,960.00
Cost of body	1,000.00
Cost of equipment	300.00
Cost of tires	1,000.00
1-Total cost, complete	$ 4,260.00

Performance Record

2-Days operated	24
3-Days idle	6
4-Days maintained (Item 2—Item 3)	27
5-Total hours operated	472.30
6-Total miles covered	1801
7-Total trips made	81
8-Total tons or packages or pieces	14,628

Performance Averages

9-Average miles per day maintained (Item 6 ÷ Item 4)	66.7
10-Average miles per day operated (Item 6 ÷ Item 2)	69.4
11-Average miles per trip (Item 6 ÷ Item 7)	22.2
12-Average tons, stops or packages per trip (Item 8 ÷ Item 7)	180.6
13-Average commercial ton-miles, package-miles or stop-miles per trip (Item 11 × Item 12)	4000.93

Recapitulation

14-Total expenses for month (Item of Items A, B and C)	$ 501.27
15-Cost per day operated (Item 14 ÷ Item 2)	19.28
16-Cost per day maintained (Item 14 ÷ Item 4)	16.17
17-Cost per mile operated (Item 14 ÷ Items 6)	.277
18-Total commercial ton-miles, package-miles or stop-miles (Item 7 × Items 12)	324,000
19-Cost per commercial ton-mile, package-mile or stop-mile, (Item 14 ÷ Items 18)	.0013

FIGURES 43 and 44: These two figures constitute one form, but for the convenience of the reader they have been given separate numbers. It is called a monthly summary of costs, but it is in reality a ledger made up from the drivers' cards.

he secures the tire cost for the month. From the bills for repairs from his own garage and from the Ajax service station, he derives the total cost of repairs to the Ajax truck. As overhauling, repainting and relettering cost $117.50, he charges $^1/_{12}$ of this or $9.79 to this account.

A spare vehicle was rented one day, and so a charge of $10 is made under the proper heading. The garage rental is fixed at $62.50 by the firm's accountant.

Totaling the three groups of cost charges, a grand total is figured and entered under Item 14. By means of the formulas in parentheses, following Items 9 to 13, the performance averages (Figure 44) are secured and similar formulas are followed for Items 14 to 19: The figures under "investment" (Figure 44) are obtained from the statements of assets in the ledger, a memorandum or from the sheet for the preceding month. Thus it will be seen that the work of keeping account of truck costs by this system is not heavy. The cards require only a few minutes' time daily and the monthly summary may be made up in less than two hours.

But any individual system, however well designed, cannot serve as a whole so long as several other cost systems, which may also be well designed, are in existence. The difficulty comes from a lack of uniformity in the treatment of various items of expense, for the experts have not agreed as to the proper way way of figuring certain costs.

The Truck Owners' Conference System. In the following pages and on Inserts I and I-A is described a national standard truck cost system designed and adopted by truck owners meeting in conferences from every part of the nation. Under the leadership of Harold P. Gould, the Truck Owners' Conference, Inc., of Chicago, set to work to design a cost system which would represent and stand the test of thousands of truck owners in hundreds of different lines of business. A committee was formed, not confined to a few experts, but having as well a considerable number of practical operators. Scores of cost systems already devised were examined. The good points of each were carefully considered and adopted wherever feasible. Tentative forms were drawn up. These forms were changed again and again, as a result of the criticism of members of the committee, and truck owners who attended the conferences. Finally, in a meeting thrown open to everybody in the industry

Form 1 NATIONAL STANDARD TRUCK COST SYSTEM. TRUCK OWNERS CONFERENCE, INC., CHICAGO. Series 1918

DAILY RECORD, MONTH OF _____; HOURS IN WORKING DAY_____

OPERATING DATA

Date	Weather	Temperature	Number of Trips	Delivery or Pick-up Stops	Total Units (See D)		Miles	Time in Hours and Minutes								OF GAL OR W.P.
					Out	In		Available but not Used		Loading		Running Includ. Stops		Laid up for Repairs		
								Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	
1																
2																
3																
4																
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6																
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25																
26																
27																
28																
29																
30																
31																
Total																

Form 3 NATIONAL STANDARD TRUCK COST SYSTEM. TRUCK OWNERS CONFERENCE, INC., CHICAGO. Series 1918 MADE BY TALI

FIXED EXPENSE

FORM 3A. INVESTMENTS			FORM 3B. CHARGES
			INTEREST * ON
CHASSIS_____CAPACITY_____MAKE_____			TAXES
STORAGE BATTERY (IF ELECTRIC)			LICENSE
BODY			DRIVERS WAGES
TOP			HELPERS WAGES (SELDOM INCL
PAINTING			GARAGE (RENT, LIGHT, HEAT, P
FREIGHT			INSURANCE
SPECIAL EQUIPMENT			
TOTAL			
SUBTRACT TIRE VALUE			
SUBTRACT STORAGE BATTERY VALUE			
TOTAL LESS TIRES AND BATTERIES (SINKING FUND BASIS)			

** MONTH COLUMN CAN BE FILLED IN ACCORDING TO LIMITS OF FISCAL YEAR. USE FIRST SPACE FOR FIRST MONTH, ETC.

*AVERAGE YEARLY INTEREST A

FORM 3C, MONTHLY ANAI

** MONTH	TOTAL FUEL COST	CYLINDER OIL COST	GARAGE SERVICE	REPAIR DUE TO ACCIDENT ACTUAL	SINKING FUND (MILEAGE BASIS)	ESTIMATED MAINTENANCE AND REPAIR	ESTIMATED BATTERY RENEWALS AND MAINTENANCE	ESTIMATED TIRE COST	ESTIMATED VARIAB MONTHI EXPENS
TOTAL									
AVERAGE									

SINKING FUND OR DEPRECIATION PER MILE (EST. LIFE_____MILES)_____ TIRI

MAINTENANCE AND REPAIR ESTIMATE PER MILE_____ BAT

with all invited to criticise or to suggest improvements, the system was adopted in the form presented in these pages.

How a Uniform System Benefits All. This standard system, establishing a uniform method of figuring all the basic items of cost and performance, provides a common language by which the experiences of all the truck operators in the country may be related and understood. It will unlock a great storehouse of information, which has been closed to the average truck owner. Even if its methods are not correct in every detail, it still provides the common measure by which every truck installation can be judged. This must always be the supreme function of a standard cost system.

A comparison of figures will bring to light many possibilities of economy as well as many causes of waste. Take the matter of supplies. A great deal of doubt exists today in the minds of truck owners as to which oil, which tires, which accessories of all kinds are the "best." Many owners admit that there seems to be no way of finding out. Suppose now that a considerable number of truck owners kept their records of tire costs according to the method set by this standard system. The reports from hundreds of truck owners, rendered in a uniform way, will tell a convincing story. They will establish proof regarding questions which heretofore have been approached only by mere guesswork.

Help From All Sides. Quite in keeping with the creation of the standard system is the manner in which it is proposed to distribute it. First of all, no one will be permitted to make a profit from its sale. Bids have been asked for the printing of the standard forms, and the work given to the lowest responsible bidder. A price has been established covering the actual cost of printing, which, in view of the great number of copies required, is purely nominal.

This system consists of seven forms which may be described briefly as follows:

Purpose of the System

The idea of this system has been to gather within a single cover the complete cost and operation data of one truck for one year (12 of Form 1 with Forms 2 and 3 making a complete yearly set); to arrange it in accessible form; and to make it as simple as possible to operate. The information as arranged is of vital importance to any executive controlling trucks, their purchase or their operation.

Divisions of the System

Directions and suggestions. A complete set of rules for figuring the different items so that a clerk or stenographer can easily keep the record.

Form 1. A form to which the daily service records and cost items are posted for monthly footing.

Form 2. A form for monthly analysis and averages per day of operating data and cost.

Form 3A. An investment chart serving as the basis for fixed expense.

Form 3B. A form for computing fixed monthly and yearly expense.

Form 3C. A form for accumulating the estimated and actual expense by months for one year.

Form 4. Daily Service Record. A daily service record, to be kept by the driver giving the fundamental operating data. (Furnished in separate pads, or may be varied and printed by each concern to suit its individual conditions.)

Distributing Costs Monthly

In compiling cost data it is well to remember that the most satisfactory results will be obtained if the costs are distributed evenly over the entire work period. This applies particularly to Interest on Investment, Sinking Fund or Depreciation, Tires, and Maintenance and Repair. Interest is paid during the Sinking Fund period. If this period has been established at only a fraction of the life of the truck, costs during the remaining life of the truck will be minus interest and sinking fund charges and, therefore, cannot fairly be compared with the former costs until a proper adjustment has been made.

For the sake of making monthly or yearly comparison in truck costs, it will also be desirable to distribute tire and repair costs over the entire period rather than lump them in the particular month when they occurred.

In this system proper provision has been made for estimating these costs, so that the owner will appreciate that while, for instance, he may have no real tire costs this month, the tires on his truck are wearing nevertheless and this month should bear its proportion of the expense when it comes.

Sinking Fund on Mileage Basis

It is a common practice to think of the life of a truck as a certain number of miles. This mileage is estimated all the way from 25,000 to 150,000 miles. It is natural to suppose that a greater mileage will cause a greater depreciation and, therefore, it ought to be equally natural to figure the depreciation on a mileage basis. Even the mileage basis can be reduced to the yearly basis.

A truck life of 100,000 miles would allow an average travel each working day for a certain number of years as below found by dividing 100,000 by 300 (working days per year) and again by the average miles of travel per day.

Life in Years	10	9	8	7	6	5	4	3
Miles per Day	33	37	42	48	56	67	83	111

Shipper's Unit

The total and average loads should be expressed in units most advantageous to the truck owner. The lumber dealer would record the truck work in thousands of feet of lumber hauled, the express company would record its work a

packages handled, the coal man in tons of coal hauled, etc. Blanks are left to be filled in with the most useful unit for each particular truck owner.

The Unit-Mile

The need of a unit to measure truck performance which would test the truck's operating efficiency and be a basis for comparative study of different trucks, or of the same truck at different times, has led to the use of such terms as "ton-mile," etc.

What the term "horse-power" means in measuring the work of an engine, the "ton-mile," etc., means in measuring the work of a truck.

Defined—the unit-mile is the carrying of one unit one mile. It is not dependent on truck capacity. The unit may be tons, gallons, packages, thousand feet, etc.

Trailers—Their Accounts

When of the two- or four-wheeled type drawn behind the truck, the cost and operating data should be kept in a separate record, mention being made in the regular truck record of its use with trailer.

When of the two-wheeled type (known as semi-trailers) drawn by the truck acting as a tractor, if one trailer unit (only) is used, include with regular truck costs and operating data, quoting trailer as special equipment. If two or more units are used with one tractor unit keep individual cost accounts, but post operating data to the tractor sheet.

Daily Record, Form 1

Weather and temperature. These items are included in this record as being of particular interest to firms engaged in such lines of business as meat packing, ice and wholesale grocery, as well as affecting operating costs generally. Letters may be used to represent weather, as R—rain and R60—rain, temperature 60°.

Cost of Repairs. These various items, Material on Chassis, Labor on Chassis, Labor and Material on Body and Repairs Necessary on Account of Accident can be had from garage reports and Daily Service Record, Form 4.

Substitute Vehicle Rental. Some concerns prefer not to charge substitute vehicle expense against a truck. If done, it should only include rental necessitated by ordinary repair and overhaul. (See directions for Form 2 for other items.)

Monthly Analysis of Operation, Form 2

A. *Number of days operated.* This item should include all whole and fractions of days when truck was actually in service. This is necessary that overhead charges may be properly distributed.

B. *Number of round trips.* Kept on Daily Service Record. Abbreviated (D. S. R.), posted to Form 1, footed and posted monthly to Form 2.

C. *Delivery or pickup stops.* Same detail as (B). This item is not intended to include traffic or accident stops.

D. and E. *Total units.....out or in.* (Fill in unit most useful.) Same detail as (B). When kept in pounds divide by 2,000 to express in tons. Packages or thousand feet require but simple addition.

F. *Miles.* At least morning and evening readings of odometer should be kept on Daily Service Record. Subtract morning reading from evening reading and follow detail of item (B).

G. *Gasoline or current.* Gallons of gasoline or other fuel or K. W. H. of current used should be kept on Daily Service Record. With this record, the detail of item (B) can be followed.

H. *Cylinder Oil.* Usually noted in pints on Daily Service Record. Follow detail as in (B).

I. *Time in hours and minutes when truck was available but not used.* Driver should note this fact on Daily Service Record for all time during regular work days when truck is idle without work. Waiting during overtime periods is not to be included.

J. *Time in hours and minutes loading.* The Daily Service Record should record *time reporting* for work, the time of starting each trip and the time of ending each trip. With this information proceed as follows: Subtract time beginning work from time out on first trip. Subtract time of ending first trip from time of starting second trip. Repeat for each trip. Subtract time of ending last trip from stopping time. Add together all this time for each day. If the lunch hour occurs between trips, subtract from above daily total the time spent at lunch. Post to Form 1, foot and post monthly to Form 2.

K. *Running time in hours and minutes including delivery or pickup stops.* Subtract the time of starting each trip from time of ending each trip as shown on the Daily Service Record. Add the results of each subtraction. If the lunch hour occurs on some trip subtract from above total the time spent at lunch. Post to Form 1, foot and post monthly to Form 2.

L. *Hours and minutes laid up for repairs.* This can be secured from notes made on the Daily Service Record. Time spent Sundays, holidays, or nights when the truck does not regularly work whould not be included.

M. *Hours with helper.* This record, including number of helpers, if any, and time when used, should be noted on the Daily Service Record.

N. *Trailer data.* Miles with trailer or any other data required may be collected on the Daily Service Record by the driver and posted direct to Form 2. Cost and operating data for each trailer should be kept in a separate standard cost set of forms.

Averages, Form 2

B1 *Round trips per day.* Divide item (B) by item (A) form 2

C1. *Delivery or pickup stops per day.* Divide item (C) by item (A) form 2.

D1. *Total units.....per day.* Add items (D) and (E) and divide total by item (A) form 2.

E1. *Average units.....per trip.* Divide item (D1) by item (B1).

E2. *Unit.....miles.* Use same unit as (D1). Divide item (F2) by 2 and multiply by item (D1), or divide item (F1) by 2 and multiply by item (E1).

F1. *Miles traveled per day.* Divide item (F) by item (A).

F2. *Average round trip distance.* Divide item (F1) by item (B1).

G1. *Miles per gallon of gasoline or per K. W. H.* Divide item (F) by item (G), total gallons or K. W. H. used per month.

H1. *Miles per gallon of cylinder oil.* Divide item (H) by 8 to reduce pints to gallons, and then divide item (F) by the result.

J1. *Average hours loading per day.* Divide item (J) by item (A).

J2. *Average minutes loading per trip.* Multiply item (J1) by 60 to ascertain minutes loading per day, then divide the result by item (B1).

K1. *Average hours running, including stops, per day.* Divide item (K) by item (A).

P. *Average speed in miles per hour.* Divide item (F1) by item (K1.)

Q. *Estimated running time per mile.* Trucks generally are equipped with a governor. Traffic conditions will not allow a truck generally to be run at its governed speed. Establish a figure which it is believed will represent the average time per mile for traffic and road conditions. If a 3-ton truck averaged 10 miles per hour, its running time per mile would be 6 minutes. This item is to be used in estimating item (R) when no recording instruments are used.

R. *Estimated time per customer's stop (in minutes).* Multiply item (F1) by item (Q). This equals running time actually required as estimated. Subtract this answer in minutes from item (K) and divide by item (C1). This will give a very close figure on the average delivery time per customer.

S. *Cost per day operated.* Divide Total Monthly Expense (estimated generally used at the start and actual later) by item (A).

T. *Cost per mile.* Divide item (S) by item (F1).

U. *Cost per unit.* Divide item (S) by item (D1).

V. *Cost per unit-mile.* Divide item (S) by item (E2).

Expense Analysis, Investments, Form 3-A

The Sinking Fund Basis for Depreciation can be best obtained by subtracting tires (and batteries, if electric) from the purchase price. After deciding by proof and investigation the actual life in miles to be expected of the particular make and capacity of unit in service such as yours, divide this net investment by this number of miles and find the cents per mile to be allowed for depreciation. Resale value at the end of this mileage can be deducted from the investment if desired. A $4,000 truck capable of running 100,000 miles in your service would figure 4 cents per mile for depreciation.

Fixed Expense, Form 3-B

Interest on investment. This investment should be the average yearly investment existing during the book life assigned to the truck, found by the use of the formula in the center of form 3.

Garage. This item should include rent, light, heat, and power, or if owned, standard items on cost of owned property as interest, taxes, insurance, upkeep, light, heat, and power.

The estimated total for the year should be noted after each item in the first column; division by 12 will give the monthly estimated fixed expense and total. When the year's actual expense is known it can be likewise divided and the actual monthly expense noted in the third column—an excellent guide in making more accurate estimates in the future.

Monthly Analysis of Cost, Form 3-C

Garage service. This item should include supervision, washing, greasing, oils and grease other than cylinder oil, and depreciation of spare parts carried in stock.

Daily Service Record, Form 4

Subject to change to suit individual conditions, this form may be added to or revised to secure the data considered essential in any situation. It should always contain the essentials called for on Forms 1 and 2. Furnished printed on stout paper, size 5⅜x9½, intended for insertion in aluminum or other driver's binder or holder to be carried on the truck.

Total Cost—Estimated and Actual

It is quite impossible at the end of any particular month to know the actual cost of operation that month because of tires not yet worn out and repairs or overhauls not yet made, but that must be made some time, for which this month's wear is responsible in proportion, and for which it should bear its share of the cost burden. Therefore, it is good practice to estimate this cost as accurately as possible for a working basis until such time as the actual costs are known.

Total costs, either estimated or actual, consist of two parts commonly known as Variable Monthly Expense and Fixed Monthly Expense.

Variable Monthly Expense (estimated). Add together, Total Fuel Cost, Cylinder Oil Cost, Garage Service, Accident Repair not absorbed by insurance, Sinking Fund if mileage basis is used, Estimated Maintenance and Repair, Estimated Battery Renewals and Maintenance (if electric) and Estimated Tire Cost.

Variable Monthly Expense (*actual*). Same as above except for Maintenance and Repair, Battery Renewals and Maintenance (if electric), and Tire Cost. For these items take the yearly actual costs and distribute by months according to mileage. (Any shorter period may be used for the actual costs, but a year is more accurate.)

Fixed Monthly Expense (*estimated*). Will include general overhead items such as Interest on Investment, Taxes, License, Drivers' and Helpers' Wages, Garage, Insurance, and any administrative overhead not included in Garage Service.

Fixed Monthly Expense (*actual*). Same as above if Taxes, License, Insurance, Garage, and administrative overhead have remained the same throughout the year, and if the driver and helpers have worked standard days with no overtime and no rate changes, otherwise an adjustment will be necessary and the actual column will contain the true expense.

Total Monthly Expense (*estimated and actual*). The total of the two preceding columns in each case.

CHAPTER VI

SELECTING THE RIGHT TRUCK FOR YOUR WORK

IN the early days of motor truck transportation, when the game was new and experience was "in the making," trucks were sold generally without regard to the specific requirements of the business which they were supposed to serve. Trucks too large in capacity, trucks too small, or of the wrong type or with bodies unsuited to the commodity they were to carry: these were some of the misfits which the business man of those days bought to haul his wares.

With the growth of the industry—with the enormous increase in the use of trucks, the manufacturer began to see that it was to his advantage to sell trucks fitted to the business of the purchaser, for such machines would be able to haul more goods at less expense than misfits, and thus by their efficient performance would make more sales. The buyer, on his side, became better qualified to analyze his own needs, and, with the help of the manufacturer and sometimes without it, he began to specify the kind of trucks he required. Today, the purchase of motor truck transportation approaches a science. Let us consider how the business man shall go about the task of selecting the right truck for the job.

A Bird's-Eye View. There are literally hundreds of different makes of motor trucks today, with often several models of each. Moreover, there are electric trucks and gasoline trucks; trucks employing the four-wheel drive, tractors, and industrials. Before the merchant begins to consider the relative merits of each of these various types, he finds it necessary to get a bird's-eye view of all types. His first step, then, is to consult some standard directory of motor trucks, such as *Motor Trucks of America*, an impartial handbook, which, first brought out in 1913, has been published annually since, and presents the

principal makes of motor trucks, giving the specifications of the various models in such arrangement that the busy merchant can compare in a few minutes' time any number of trucks with respect to capacity, type, engine, drive, parts and a score of other important features. Figure 52 is a reproduction of a page from this valuable handbook.

After the purchaser has got his bearings and learned something about the extent of the market from which he may buy, he should next consider what qualities he requires in a motor truck, which will best adapt it to his special requirements.

Capacity of First Importance. The carrying capacity of the motor truck is perhaps its most important feature, and has a vital relation to the work the truck will perform, and the cost of performing it. If too large a carrying capacity is specified, the truck owner will have on his hands an expensive investment of which he cannot make full use; and on the other hand if he selects too small a truck he will not be able to deliver his goods in the time allotted and his service to customers and to himself will suffer. How shall the merchant analyze his hauling problem in order to determine what carrying capacity his truck should possess?

The fundamental condition affecting carrying capacity is the size of the average load. If the merchant must deliver three-ton loads, obviously he should select a three-ton truck. If his loads average four tons in weight, it will be more economical to use one 4-ton truck rather than two trucks of half that capacity.

It is seldom, however, that the problem is so simple. It often happens that the merchant has loads of varying size to haul. Here the decision often depends on the character of the load, that is, whether it may be divided into smaller loads or must be carried as one piece. If the merchant receives shipments made up of small units, he can make up his loads into any size and is not forced to buy a truck of any specific capacity. The determining consideration will probably be that of idle time. Thus, suppose a man is so situated that he can use either a 5-ton truck or a 2½-ton truck in his business, giving each a capacity load. While each truck is working the 5-ton vehicle is hauling the goods more economically than the 2½-ton, for it is carrying twice as much, but is not costing twice as much—the driver's wages, for instance, may be the same, and other items of expense, while greater, may not amount to double. But suppose it happens

G. M. C. TRUCKS

Manufactured by

GENERAL MOTORS TRUCK CO., Pontiac, Mich.

Model	16	21	A—21—B	A—41—B
Capacity	½ ton	1 ton	1½ tons	3 tons
Drive	Bevel gear	Worm	Worm	Worm
Chassis Weight	2,875 lbs.	3,794 lbs.	4,110 lbs. 4,150 lbs.	4,535 lbs. 4,580 lbs.
Chassis Price	$1,395	$1,950	$2,350	$3,690
Engine	Continental	Continental	Continental	Continental
H. P. (S.A.E.)	22.5	22.5	22.5	37.22
H. P. (Actual)	27.50	31	30	35
Cylinders	4 en bloc	4 en bloc	4 en bloc	4 en bloc
Bore	3½"	3½"	3½"	4½"
Stroke	5"	5"	5"	5½"
Wheel Base	132"	136"	130"—144"	144"—158"
Tread Front	56"	58½"	58½"	58½"
Tread Rear	56"	58"	58½"	58½"
Tires Front	35x5" Pneu.	34x3½"	36x3½"	36x4"
Tires Rear	35x5" Pneu.	34x5"	36x5"	36x4" dual
Frame—Pressed.				
Front Axle—I-section Elliott.				
Rear Axle	Weston-Mott ¾ floating, round	Timken semi-floating, round	Timken full-floating, round	Timken full-floating, round
Springs Front—Semi-elliptic.				
Springs Rear—Semi-elliptic.				
Carburetor—Marvel automatic.				
Cooling System—Pump.				
Oiling System	Splash and force	Splash and force	Splash and force	Splash—pressure
Ignition—Magneto.				
Control—Left drive, center control.				
Clutch—Dry plate.				
Transmission	G. M. C. Selective, 3 speeds	G. M. C. Selective, 3 speeds	G. M. C. Selective, 4 speeds	G. M. C. Selective, 4 speeds
Brakes	Internal and external rear wheels	Internal on rear wheels	Internal on rear wheels	Internal on rear wheels
Steering Gear—Screw and nut.				

Equipment—Model 16, two oil side lamps, one oil tail lamp, mechanical horn, jack, tire pump, oil can, five instruction books and two spare parts books, tool bag and tools. Models 21, 31, 41, two oil side lamps, one oil tail lamp, mechanical horn, screw jack, oil can, four instruction books and two spare parts books, three tool bags and tools.

FIGURE 52: This is a slightly reduced reproduction of a page from *Motor Trucks of America*, in which trucks manufactured in this country are accurately described. It is issued annually with the object of supplying a guide for the truck buyer desiring to study details of manufacture and equipment.

FIGURE 53: This special body for collecting street rubbish has a roof made up of six sections. When a compartment is filled its roof section is fastened down over it and the scattering of dust and dirt is reduced to a minimum.

FIGURE 54: This truck body is specially adapted for carrying window sash and door frames. Notice the high stake sides and the curved guard rail at the front which prevents a forward surge of the load against the driver's cab.

that the larger truck, while busy on Monday, Wednesday, and Friday, has little or nothing to do on Tuesday, Thursday, and Saturday, while the smaller truck is busy all the week. Obviously the smaller truck, costing more *per trip*, costs less *per week*, and should be selected

Suiting the Truck to the Load. On the other hand, suppose that the merchant is dealing in heavy objects such as machinery, which cannot be divided into smaller loads, but must be carried as a unit. Here it would seem that he is forced to select a truck capable of carrying the maximum load, for, if he does not, he is inviting overloading, which will inevitably damage his truck. If these heavy loads are exceptional, it may actually pay to overload the truck, cautioning the chauffeur to drive slowly—in other words the damage resulting from this occasional overloading may be more than compensated for by the economy of using a truck which is better fitted to the *average* requirements of the haulage conditions. This is at best, however, a dangerous practice and the truck owner should go into it with his eyes open, recognizing that he is subjecting his machine to strains greater than it is intended to bear, for the sake of securing an important economy elsewhere, and that he should not hold the manufacturer responsible for any resultant damage. Perhaps a better way of solving that particular problem is by using a trailer for such exceptional loads.

Let us look at another phase of this same problem. Suppose a merchant has a certain route in a certain section of the city on which he finds it advisable to use one truck. Although his load consists of separate units, from the point of view of carrying capacity, it must be often considered as a single unit, because the merchant may find it necessary, in order to give service, to deliver *all* the goods on one trip. This merchant, then, faces the problem of a *maximum, indivisible load* just the same as the dealer in heavy machinery, and must solve it in the same way: he must select a truck able to carry his maximum load or else overload his truck, or use a trailer. He has, of course, another option, that of making a second trip, but this may prove expensive and also result in late dellveries to a portion of his customers.

At this point it will be seen that the selection of proper carrying capacity is influenced by considerations of scheduling and routing, and service to the customer. For instance, one concern may need to make two trips a day into a certain territory,

another four trips, and still another may have to deliver the entire order of merchandise on one trip, and will have to select carrying capacity accordingly.

The practice of concerns in competitive lines of business will often help the merchant in selecting a truck of proper carrying capacity, although his own individual requirements must always be the determining factor.

Before a final decision is reached on the question of carrying capacity, the merchant should consider whether or not he has selected a truck which is heavier than the laws of his state allow him to use. Certain states have passed regulations limiting not only the weight per inch of tire width, but the total weight per wheel of motor trucks used on their highways. This is explained in Chapter XXXI and should have the attention of the truck buyer before he makes his final decision.

Power. While carrying capacity generally implies strength, it does not necessarily indicate power, and frequently trucks able to *support* great loads do not possess the power to haul those loads over severe road conditions. Let us take for instance such conditions as are presented by the cities of Detroit and Pittsburgh. The former city is practically level, the latter abounds in grades varying from 10% to 30%. It has been found that trucks built for service in Pittsburgh must have a different gear reduction than that of trucks used in Detroit. Steep hills require greater tractive force at the driving wheels of the truck, and this is supplied by changing the gear ratio—giving the engine a longer lever to work with.

This is a point which should have the close attention of the prospective truck owner. If the territory which he intends to cover abounds in steep hills, he should specify a gear ratio which will enable his truck to negotiate those conditions effectively. This is a matter for exact determination. Weight carried, character of load service, and percentage of grade, as we show in Chapter XI, are the determining factors. A simple calculation will show what tractive force is required to propel a truck over given conditions; and the gear ratio should be designed to provide it.

Adjusting the Speed to the Business. Closely bound up with the matter of carrying capacity is that of the speed of the motor truck. As a general rule, heavy trucks, that is, trucks able to carry great loads, must travel slowly, whereas light trucks

are capable of considerable speed, certain very light delivery cars, in fact, having the same speed as ordinary passenger automobiles. Speed is gained at the sacrifice of carrying capacity, and this constitutes the problem of the prospective truck owner in his selection of a speedy truck—whether or not his gain in ability to cover ground is offset by the decreased size of his load.

Where the size of the load is a fixed quantity, the speed of the truck is generally fixed also, and is not subject to change beyond certain limits. But where the size of the load can be reduced or split up into more than one shipment, it is possible for the merchant, by planning his delivery system, to select a truck of such speed that he can make deliveries more economically with a fast truck of limited capacity than a slower truck which might be able to carry twice or three times the load.

Take for instance, the whole field of package delivery, in which so many thousands of light, speedy delivery cars are used. We will say that a certain dry goods concern has four tons of packages for distribution in a suburb ten miles distant. To begin with, here is a capacity load for a 4-ton truck, and such a truck capable of fifteen miles an hour is accordingly used. When the truck, however, arrives at the suburb, what is done? Instead of delivering the packages from the 4-ton truck, the merchant may select four 1-ton delivery cars, among which he divides the total load. What does he gain by this selection of trucks for the special job? First—service; for if he continued to use the heavier and slower truck, it might be several hours before the last of the packages was delivered. Second—economy; for the standing time caused by the hundred or more stops during the day does not cost nearly as much with the fast, light, and comparatively inexpensive delivery cars as if the heavy and comparatively expensive truck were used. Moreover, the greater speed of the light cars does much to compensate for their smaller carrying capacity.

Consider on the other hand the merchant who operates his trucks in congested districts. Here speed is of little avail, and it may be profitable to sacrifice it to carrying capacity, hauling huge loads, but at a rate of speed no greater than that of street traffic. By such a selection, conditions which are generally thought to be unfavorable, are neutralized.

Size of Body. Carrying capacity and size are often confused. Frequently merchants having bulky loads to haul,

select the largest truck they can find—which is often the heaviest. On the other hand, other business men, who must haul heavy but compact material, make the mistake of selecting a small truck—one with sufficient *room*, but not sufficient strength or carrying capacity to sustain the load.

Weight is here the determining factor. Almost any kind of body can be built on almost any kind of truck chassis, within limits. A body which may *seem* to be top-heavy, may be used successfully to carry empty barrels or boxes. On the other hand, a body which may seem to be admirably proportioned to the truck chassis, may be the means of overloading that chassis even when it is only half filled with kegs of nails, lead pipe, or other heavy material.

While bodies may be made in many shapes and designs, as we show in Chapter X, the prospective truck purchaser should bring his requirements to the attention of the truck manufacturer at an early date, as certain truck models are specially suited to carry certain kinds of bodies. Thus, some manufacturers make special "Lumber Truck" models, designed with a long wheel base to support a long body for handling lumber. Other models may have a wide frame, the better to support a wide van-like body, such as is often used in the transfer business. Many truck manufacturers make their own bodies, or else have arrangements with certain body makers, so that the truck buyer can be assured of a body fitted to the trucks and to the load it is to carry.

Operating Conditions that Influence Selection. The truck buyer should be on his guard lest he select a body which is wider or longer than the law allows. Width, especially, has been limited by ordinances in most states and cities, because obviously a truck with an unusually broad body might be dangerous on narrow roads. Moreover, bridges, ferryboats, and so forth, have limited dimensions, which must be taken into consideration. This is more fully discussed in Chapter XXX.

Other factors which affect the size of the truck rather than its carrying capacities, are length of wheel base, amount of clearance above the road and height of body. Some manufacturers specialize in trucks having a short wheel base. Such a truck is not necessarily limited in body capacity, because its compact size is generally gained by locating the engine under the driver's seat. The over-all length, however, may be considerably reduced, which enables such a truck to maneuver in narrow alleys,

congested streets, and so on, where a larger truck would be at a disadvantage.

The space between the lowest part of the truck mechanism and the surface of the road, is its clearance. This may or may not be of importance—but is generally a factor to be considered where rough, rocky roads are encountered, or ground so soft that the truck wheels sink deeply in. The height of the body from the ground may be an important factor. It is often advisable to see that the body of the truck is on a level with the top of the loading platform, as this facilitates the loading and unloading, and may become a matter of very first importance where heavy material is handled.

Types of Trucks. Having considered the important qualities which can be found in varying degrees in *all* trucks, the business man should next turn his attention to the different *types* of motor trucks which have been developed to meet different haulage conditions. The more important types are as follows:

Gasoline-Driven Trucks:

1. Rear-Wheel Drive
2. Four-Wheel Drive
3. Tractor-Trucks

Electric-Driven Trucks:

1. Street Trucks
2. Industrial Trucks

Gasoline trucks having a rear-wheel drive constitute the majority of commercial vehicles in operation today. This type can, in fact, be considered the "regular" construction, other types being specialized developments for special kinds of work. There are three systems for delivering the power of the engine to the rear or driving wheels of this kind of truck: the first and oldest is the familiar chain drive; A second is the worm drive, and the third is the internal gear drive. Each of these types of drive has its supporters, and it will not profit us to go into the engineering claims of these three schools of design. Let it suffice to add this word of caution: No type of drive has ever been invented that increases the leverage with which the power of the engine is brought to bear on the driving wheels of a truck, without reducing the speed of that truck correspondingly. Most transmission systems involve a series of gears, and where a seemingly advantageous leverage is secured on *one* gear, it is paid for by an increased strain on another gear or train of gears.

The Four-Wheel Drive Type. One of the most striking developments in the application of final drive to gasoline-driven

motor trucks is that of the four-wheel drive. The principle of this type is simple. Wheel traction is largely a matter of weight. When locomotives were propelled by only one pair of driving wheels, it was found that by connecting these wheels by rigid bars with the wheels behind them, better traction was obtained on difficult grades. The power of the locomotive as a motor was not increased, but the purchase of the wheels or rather of the entire locomotive, on the tracks, was almost doubled.

It is somewhat the same with a truck. If, when loaded, it bears 75% of its weight on the rear axle, it is using only that proportion of its weight to get traction. A truck using a four-wheel drive employs 100% of its weight to secure traction. But to put six driving wheels under a truck instead of four would not increase its tractive power because the total weight, already utilized by the four-wheel drive, is merely divided up into six smaller parts without any net gain.

Manufacturers of four-wheel drive trucks claim another advantage which is not included in this theory of traction. Often a truck will get stuck in difficult ground where the rear wheels can get no grip but where the front wheels rest on solid earth. It is obvious that if power can be transmitted to these wheels, they will draw the truck out.

With the increased use of trailers, it became necessary to develop a truck which should have greater pulling power than possessed by a vehicle designed merely to haul its own load. This was accomplished not by increasing the power of the engine, but by increasing the leverage with which that power could be brought to bear on the driving wheels of the truck. The means employed is an increased gear ratio—equivalent to using a longer lever. Thus, in some tractors, the engine is made to turn over sixty times for every single revolution of the driving wheels. In this way enormous power is gained, but always at the expense of speed. This power is absolutely required, however, as when the tractor is forced to start a heavy train of trailers on a steep grade. While, as we have said, the horse-power rating of tractors is frequently no greater than that of ordinary motor trucks, the effect of using these enormous leverages has been to place an increased strain on various parts of the mechanism. The tires, wheels, pinions, driving shaft, and other parts of the tractor may be considered as constituting a longer lever against which the engine leans as it applies its power to the road. These parts, therefore, must be made stronger than in ordinary trucks.

On page 198 is presented a table giving the special requirements of the average tractor.

Advantages of Electric Trucks. One of the most important questions which the prospective truck owner has to decide is whether an electric or a gasoline-driven truck is better adapted to his haulage conditions. The electric truck differs radically from its gasoline-driven brother, in that its power is applied in a steady stream, so to speak, and can be increased by a mere push on a lever to any desired strength up to its maximum. Its motor is rotary, and not reciprocating; and does not involve the use of gas explosions. From this fundamental character of its propulsive power, proceed several important advantages. Let us list them below:

1. Ease and economy of maintenance, due to absence of change-speed gears, cooling system, ignition system, transmission clutch, carbureter and reciprocating engine.

2. Ease of operation, due to the fact that the driver needs merely to advance or retard a lever in order to get the right amount of power to overcome a given haulage condition. This fact also simplifies the driver problem.

3. Economy in starting and stopping and operating in congested districts; for the electric truck has the same rapid acceleration as the street car, and the extreme flexibility of its power control enables the operator to adapt its speed to all conditions of traffic.

4. Other minor advantages, which vary in importance according to conditions—such as silence in operation, absence of fire hazard (important on wharves), dependability (which is a result of its simplicity of maintenance and operation), and the facility with which its power can be used to operate auxiliary devices, such as winches, cranes and so forth, should be considered.

In view of these important advantages, it may be asked what prevents the universal adoption of electric in place of gasoline-driven trucks? The answer is chiefly found in the dependence of the electric on a generally fixed source of supply for its current or power. Although improvements are constantly being made in battery construction, the average electric truck cannot travel more than forty-five miles a day, under normal conditions with one battery charge. If the daily distance traveled is in excess of this amount, or if the haulage conditions are so severe as to require an unusual expenditure of electric power, larger

batteries or "boosting" stations must be provided. To this fundamental disadvantage is added another—the limited speed of the electric truck. For example, an electric truck capable of making but ten miles an hour is at a tremendous disadvantage when competing with a gasoline truck which can make twenty. But suppose the traffic conditions are such that the gasoline truck cannot make use of its greater speed, but is forced to travel at the same rate as the electric. This is a phase of the matter which must be taken into consideration.

The Field of the Electric. Not long ago a scientific investigation was undertaken under the auspices of the Massachusetts Institute of Technology to determine the relative fields of horse, electric, and gasoline trucks. The conclusions of this investigation are presented in the two charts shown in Figures 55 and 56. Figure 55 has to do with parcel-delivery conditions, and Figure 56 with bulk-goods delivery, such as coal, gravel, and so forth. Mr. H. F. Thomson, who conducted the investigation said, with reference to parcel-delivery conditions:

"These curves show that, for the characteristics considered, the total cost of delivering within a two-mile radius is practically the same for horse wagons and for electric cars, and that for delivering in zones beyond the two-mile radius the cost by electric cars is less than by horse wagons, the difference increasing with the distance of the zone from the distributing point. The cost of delivering by gasoline cars is greater than by either horse wagons or electric cars for the short-haul territory, becomes approximately equal to the cost by horses after the eight-mile radius, and gradually approaches the cost by electric cars as the distance of the zone increases.

"The electric car is not indicated as operating beyond the ten-mile radius, because at this limit the car is considered to travel 42 miles per day, which approximates the distance that an electric machine may be expected to average conveniently day after day, under normal conditions at the present time. Operation beyond this limit would require additional expense for large batteries, relay batteries or boosting equipment, which has been considered. By the so-called 'battery-exchange' system, which has been established recently in a few cities, and whereby the operator purchases battery service including power in accordance with a definite system of rates, this limitation in the daily mileage capacity of an electric car in city work is largely obviated.

"The estimates for bulk-goods delivery are drawn up in the same manner as the estimates for parcel delivery. In this case a coal-delivery service in particular is considered, but the results also apply to the handling of other bulk goods, such as stone or lumber. The loads are considered delivered at different distances from the loading point, and the results are expressed in 'dollars per load delivered.' These data are plotted in the figures on the opposite page in order to show the relative expenses of delivering by the three types of trucks with different lengths of haul. From these curves it will be noted, that,

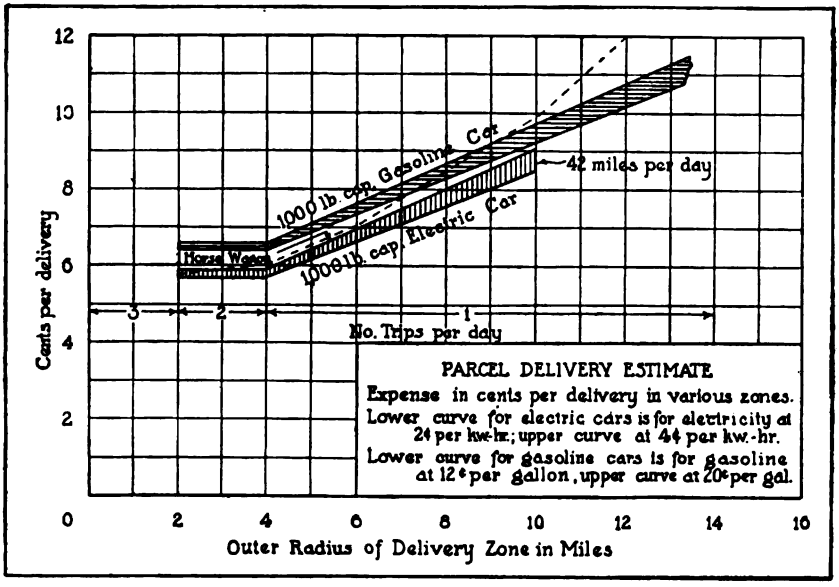


FIGURE 55: Conditions determine whether a horse and wagon, a gasoline truck or an electric truck should prove most profitable. One expert has figured out the field of each in this chart. The business chosen involves package deliveries.

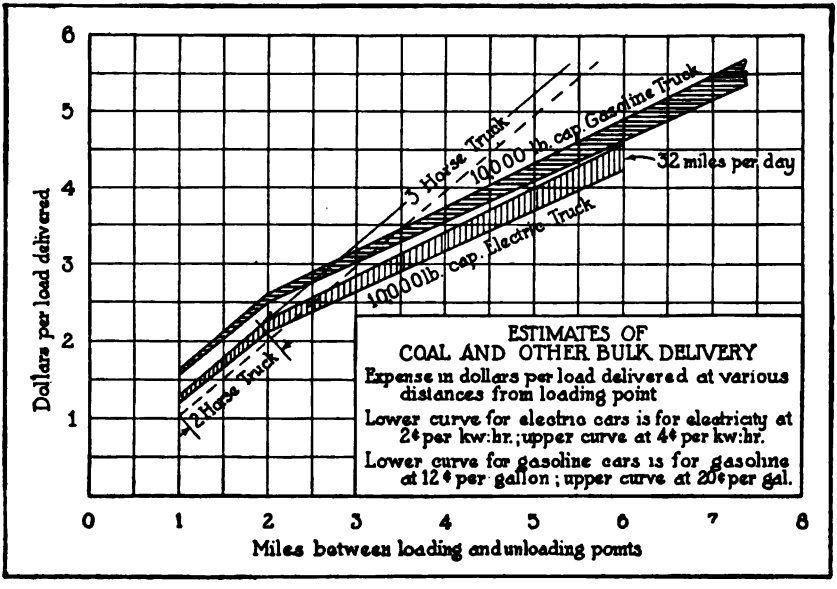


FIGURE 56: The problem is a little different for bulk delivery. Here the "field" of each vehicle is outlined. Even if you are not facing this problem the chart will assist you in deciding whether you have chosen the right transportation.

FIGURE 57: This is one type of the industrial truck. It is designed primarily to carry its own load. It will also serve to illustrate another classification of industrials —the drop frame. The two figures on this page will make these differences clear.

FIGURE 58: This industrial truck has a body of the "straight-frame" type, much like that of the ordinary commercial truck. The top of the body is on a level with the floor of baggage coaches, which makes it a simple matter to transfer trunks.

FIGURE 59: The industrial truck has many uses. Hauling a heavy steel girder from one point to another in a large plant is only one example of its effectiveness. It is easily managed and its size makes it easy to travel most anywhere.

FIGURE 60: The little platform to the left becomes a body when the industrial truck's platform passes under it, elevates it an inch or two and makes away with it. Twenty or thirty of these platforms would cost only as many dollars.

FIGURE 61: The time was when only the larger oil companies had tank bodies for transporting oil. Today even the small dealers use these tank bodies, which have made an otherwise dangerous undertaking a comparatively safe one.

FIGURE 62: Molasses, not oil, is being carried in this truck. There are few liquids which cannot be handled in this manner. What is more, the electric truck prevents any possibility of odors contaminating the contents of the tank.

for hauls of two miles or less, the cost by horse wagon is less than that by either electric or gasoline trucks; for hauls between two miles and six miles, the electric truck is cheaper than either horse wagon or gasoline truck; and for hauls of more than three miles, the gasoline truck is cheaper than the horse wagon, but not so cheap as the electric at least within the six-mile radius.

"The electric truck is not indicated for hauls of more than six miles, for which distance the daily mileage is 32, because this approximates the limit of work which a large electric truck can do conveniently day after day upon a single battery charge. The complete outclassing of the horse wagon by the motor truck for hauls exceeding three miles is clearly shown in these figures. Although no limit is shown for the operation of gasoline trucks, such an economic limit would exist, in the transportation of a given commodity, at the point where the smaller expense of hauling by trolley or by short-haul freight would offset the advantage of quicker deliveries and the saving in rehandling expense due to handling by motor truck."

Industrial Trucks. The types of trucks we have thus far described are used for road service. There is, however, a very considerable transportation problem inside the factory, the store, the warehouse, or the yard. Goods often must be hauled from building to building or between different parts of the same building. Sometimes this is done by hand truck. A better means, however, is the industrial truck, a compact, powerful truck generally operated by electricity, and capable of carrying up to two tons and hauling several tons on loaded trailers behind it.

There are two general types of industrial trucks: One a machine carrying its own load (Figure 57), and the other an industrial "tractor" (Figure 58), especially designed to haul several loaded trailers behind it. Of the load-carrying machines, two distinct types of frames are offered by the makers—the so-called "straight frame" (Figure 58), and the "drop frame" (Figure 57), types. Modifications of each type of frame have been worked out in order to adapt the truck most satisfactorily to the class of service in which it is intended to be used, whether railway, marine, or general industrial work.

While the trucks differ materially in appearance, the manufacturers aim to embody the same mechanical and electric details in them, thereby simplifying renewal of parts and so forth. The average capacity of the load-carrying trucks is from one to two tons, and for railroad service the 2-ton size seems to be about the standard. For peculiar conditions met with in certain fields of industry, notably sheet iron, structural iron, and wire mills, a special type of electric tractors and trailers has been evolved. The mechanical points, tires used, and so forth, are generally

the same as in the other types. An interesting feature of the mechanism of electric tractors as developed by some manufacturers after very exhaustive tests, is the automatic circuit breaker. This is designed to break the connection whenever the drawbar strain imposed on the motor exceeds a fixed point. This insures a protection to motor, battery, and tires that will readily be appreciated by users.

Industrial Trucks Becoming Popular. New uses for the industrial truck are constantly being found. Several years ago the government adopted them for use in our arsenals, and following England's precedent, practically all the factories making munitions are using these "electrics," and are finding them indispensable. The most overworked industry during the last two years has been the munition industry, and it has probably suffered most through lack of men, and yet with the aid of electric industrial trucks it has been possible to tide over the labor scarcity. Some manufacturers accomplished this through the use of conveyors, but the munition men found that the storage battery truck met their requirements much more suitably, first—because the electric industrial truck could do all and more than a conveyor at a much less cost; second—because there was the danger of friction with conveyors; and third—they are more mobile. Special models have been designed with separate compartments for the transportation of shrapnel and other shell, and large numbers of these trucks are being operated in England by women, thus further releasing man-power.

A prominent gasoline automobile company has a fleet of 49 electric industrial trucks, and in its plant which covers about 110 acres of floor space, the average hauls are 150 feet, and these little trucks successfully pull loads up 12% grades. Their entire fleet is housed in an 80 by 80 foot garage. The operating record of a 2-ton truck was kept during one month, and the average cost per ton-mile follows:

Labor	$2.040
Power	.066
Maintenance	.010
Investment and depreciation	.017
Average total cost per ton-mile	$2.133

This truck averaged 3.7 miles per day loaded, plus the same mileage empty, and its average daily total tonnage was 14.1. A single example of the labor saving effected in one department

of this plant plainly proves the economy of the industrial truck. Eighteen men were formerly needed to unload storage batteries from freight cars, and eight men with one electric industrial truck now do the same work, and do it faster.

Quality Always an Important Factor. After the business man has surveyed the broad field of motor trucks, examined the special qualities of different models and makes, and determined what type of truck possesses to the highest degree those qualities required by his own haulage conditions, he is in a position to make a choice based on sound reasoning. One question, however, remains to be answered. "What 'quality' shall he select?" "What price shall he pay?"

The answer, of course, is: the most economical. But what is the most economical? Initial cost does not tell the story.

If only the purchaser could look ahead three or four years, and discover what expense he will be caused by repairs, by maintenance, by lay-ups, due to defective parts, or parts made of material not the best—if he could see in advance the date when his truck would be worn out finally and beyond redemption—then he would be in a position to determine the final cost of his investment. Suppose a truck rated to carry the same load as another costs two-thirds as much and lasts only half as long!

Quality endures—but a makeshift goes to pieces from year to year and even from month to month. One expert says:

"If high quality and its attendant price did not correspondingly mean low maintenance cost, then all that has gone before in the development of those metals which make up the component parts of every high grade truck has been wasted effort. If quality were not the basis of low maintenance cost, why should we have chrome steel, nickel steel, why vanadium steel or any of the other numerous metallic compounds; why should the names of Damascus, Sheffield, Krupp and Fagersta be synonymous with the highest quality in steel production known to science? Unless you have purchased trucks of quality, you can expect nothing but high maintenance cost and interrupted service. Without quality, no matter how adequate your service inspection, no matter how complete your system, no matter how carefully any of your other plans may be laid, you will not be able to throttle the high cost of keeping your trucks in repair.

"The quest for quality leads to the door of the truck manufacturer himself. No manufacturer can long exist who does not give full money value for the price he may be obliged to place upon his product. The history of the industry itself substantiates that fact. Up to June 1, 1917, 476 manufacturers had entered the business: of that number 200 are in business today. Of these 200, 49% are less than one year old. Of all the manufacturers who had entered the business prior to January 1st, 1917, 42% remained in business for a period

not exceeding one year. Of the 200 manufacturers existing on June 1, 1917, only 20 had continuously conducted their business for a period as long as five years, and of these same only 30% are three years old and over!"

Can Truck Makers Give Service? Reputation and stability generally indicate quality, and are a sufficient guarantee of value received. The ability to give service also counts. Obviously a small company, or one which is not widely represented by agencies or direct branches, is not in a position to render prompt or efficient service. On the other hand, the business man should see that there is another side to the "service" question, and that, if he wants "the best hotel service," as one manufacturer termed it, he must pay for it. This truck maker summed up the philosophy of "service" to the truck owner as follows:

"It is the duty of the manufacturer to make provision for prompt service in the way of repair parts, to provide the customer with an illustrated parts list, so parts can be ordered intelligently, but if a part is broken through the carelessness or recklessness of the driver, while the customer should be able to get the repairs promptly, he should pay the expenses of making the repairs.

"Having served the customer faithfully and well in the points mentioned, we believe that constitutes all the 'service' that should be guaranteed a purchaser of a motor truck of known reputation.

"The more the purchaser of a truck assumes the responsibility of its care, the better satisfaction he will get out of his purchase and the better 'booster' he will be for the manufacturer whose truck he uses."

Standard Parts Desirable. In this connection the matter of the parts of which a truck is made should not be overlooked. Most trucks are "assembled"—that is—made of parts which are bought from manufacturers who specialize in certain products, such as axles, bearings, carbureters, etc. When such parts prove defective, the matter of service is "referred" to the parts maker and not the truck manufacturer, whereupon the question once more is raised: are the parts of a truck made by well-known manufacturers who are equipped to give service on them, or are they made by concerns who are not well known and not able to give prompt service when it is requested?

If the business man can, by a process of elimination and selection, narrow his choice to one make of truck, he secures the final advantage of standardization of his equipment. A fleet of trucks, all of which are of the same make and built with parts which are interchangeable, is obviously much easier to take care of and to maintain than a fleet consisting of different makes, models, designs, and types. This is the goal of scientific truck buying—one seldom attained, but to be striven for nevertheless.

PART II

MAKING YOUR MOTOR TRUCK DO MORE AND BETTER WORK

Univ. of California

CHAPTER VII

PLANNING THE DELIVERY SYSTEM RIGHT

As the truck is a vehicle of speed, all the means by which it is served, loaded, and sent on its way, must be speeded up also. If this is not done, the best truck in the world may prove a flat failure. But if, on the other hand, the most efficient methods for eliminating waste time in the order department or the shipping platform, and in the scheduling and routing of the cars themselves are studied and put into execution, even an inferior truck may prove a profitable investment.

Let us go into this matter more fully, and show how truck owners, by properly planning delivery systems, can eliminate delays which cost their business many dollars a day.

A certain retailer once observed four of his fleet of six trucks standing idle at his shipping platform. This seemed strange to him, inasmuch as he had revamped his shipping room and installed quick-loading devices. He prided himself on his up-to-date methods of loading his truck.

The First Essential. Somewhat nettled, he investigated the matter at once. He discovered that his quick-loading devices were in good working order and were being used. He knew that, so far as mechanical means were concerned, his delivery system was beyond reproach. The real difficulty became apparent to him, however, when he found this machinery waiting for merchandise to handle. With a last glance at his idle trucks, the retailer strode back into the store.

And here he found out, what every truck owner will discover if he investigates the matter, that his first problem was a clerical one. This merchant while perfecting the means for hoisting the loads upon his trucks had neglected to forge the first link of the chain, that is, an effective means for assembling the orders and making them into loads. He found that orders were being

filled as received, that they were being laid down without reference to the zone in which they had to be delivered, that loads were being assembled without reference to the probable time of return of a certain truck. Worst of all, he discovered that a truck waiting outside was being held up, although its load was all ready for it, while a cargo was slowly being assembled for truck number 2, which was at the loading dock.

A Zone System for All Orders. The merchant forgot about his quick-loading devices for the moment, and turned his attention to replanning his delivery system inside his store. First, he established a zone system for all orders. True, each truck had been given its special route, because it was apparent that the drivers by making the same territory every day would become familiar with the streets, the stops and the customers, and thus gain greatly in effectiveness. But the clerks inside the store were not very familiar with these zones. The proprietor issued instructions that every invoice and shipping ticket should be stamped with the zone number as soon as they were made out.

He then had bins built, one for each zone, where the orders were assembled. He created the position of truck dispatcher, and put one man on the platform in charge of all loading. As the orders were assembled, the invoices were turned over to the dispatcher. He sorted them according to the location of the stops, and the packages were arranged in reverse order in demountable bodies. Previously the drivers had spent some of their time doing this work.

A Dispatcher Simplifies the System. The dispatcher was given a desk, and soon new evidences of efficient planning made their appearance. First was a route sheet, giving the numbers of all the trucks, their time of arrival, of leaving, and the destination of each trip (see Figure 63). This gave the dispatcher a bird's-eye view of the whole situation, and enabled him to tell where each truck was at any hour of the day, and to calculate closely the time of its return. With this information at hand, the dispatcher could direct the efforts of the order department. Thus, if the truck covering route number 4 were scheduled to return to the store in half an hour, the dispatcher sent word to the order clerks and shipping clerks to give preference for the time being, to invoices stamped Zone 4, in order that a load might be assembled before the truck returned. Previously, no set system had been followed in this regard, with the result that although

there was generally a load on the platform, some other truck than the one for which the load was waiting was in the yard.

The dispatcher went further and increased the effectiveness of his route sheet by carefully studying the time. Without interfering with his duties in the least, he kept minute records of the time required to load certain kinds of merchandise, and the time to make the round trip. He asked the driver to telephone him immediately upon arrival at a certain point, and in this way he established standard records for covering certain well-established routes. Occasionally he made trips with some of the drivers, and in this way learned the time required to unload or to make deliveries.

UNITED FUEL & SUPPLY COMPANY

MOTOR SERVICE DEPARTMENT _____ 191 __ **DAILY ROUTE CARD**

Truck Number	Driver	Yard	Stop First	Truck Number	Driver	Yard	Stop First	Truck Number	Driver	Yard	Stop First
1200				1150				1212			
1201				1151				1213			
1202				1152				1217			
1203				1153							
1204				1154				1159			
1205				1155				1161			
1206				1156				1162			
1207				1157				1163			
1208				1158				1164			
1209				1159				1165			
1210				1160				1166			
1211				1161				1167			
1214				1162				1169			
1215				1163				1169			
1227				1176				100			
1228				1177				101			
1229				1178				102			
1230				1179				103			
1231				1180				104			
1232				1181				105			

FIGURE 63: Where is such and such a truck? Where has it gone? When is it likely to return? Which truck is best able to handle this rush order? These are some of the questions which this route sheet enables a Detroit fleet owner to answer.

Simplifying Load Assembly. Soon he had complete time charts covering all the important routes, and giving him almost to a minute the length of time required to make various trips under normal conditions. While he was able to make use of this information in a number of ways, such as replanning deliveries, testing drivers, and the like, we are considering here its effect on planning the order system. Used in connection with his

route sheet, it enabled him to plan almost to a minute on the return of a given truck. It became possible to assemble loads in such a manner that the first truck to return would find its load first in order on the shipping platform. It enabled the dispatcher in many cases to get in touch with a truck on the road by telephone and give eleventh hour instructions, and thus take care of special emergency orders which came in.

Planning the delivery system begins inside the store, and as we have shown, the first step in working out the problem is to have the load ready when the truck is ready, and the right load for the right truck. It is possible under certain conditions to work out a schedule that is as fixed and dependable as a railroad time table.

How trucks at work for a Chicago mail-order house are operated on a strict fifteen-minute schedule is shown in the time table below:

SEARS-ROEBUCK TRUCK RAILROAD SCHEDULE

Truck No.	1	2	3	4
Warehouse Arr	7:30	7:45	8:00	8:15
Warehouse Lve	7:45	8:00	8:15	8:30
Plant Arr	8:00	8:15	8:30	8:45
Plant Lve	8:15	8:30	8:45	9:00
Warehouse	8:30	8:45	9:00	9:15

On the other hand, a great many truck owners fail to develop any definite system of trips, and as a result permit their trucks to spend valuable minutes at the store or warehouse—not loading but merely waiting their turn. A scientific investigation undertaken in an eastern city showed that trucks spent more time at the stores than at the railroad yards.

How a Grocer Handles His Loads. This is how a grocer handled the problem of getting the order to the truck by the quickest and safest way. He found that items, and even orders were being neglected, delayed or sent to the wrong customer. This was particularly true of telephone orders where the customer was not present to focus the clerk's attention on his wants. This confusion in the order department was reflected at the shipping dock where orders were lying about incomplete and badly arranged. Trucks were sent over duplicate routes, and again had to be sent out a second and a third time to correct errors caused by poor planning. This condition became so intolerable that the grocer set about to overcome it through the

use of a system employing several bins. He described his new system as follows:

"At the rear of our store is a separate room for the handling and assembling of orders. Around the walls I built a tier of shelves, three deep, divided into thirty-three numbered bins in which orders are held until checked into the delivery boxes by the shipping clerk. The front of the store, chiefly for convenience in accounting, I divided into the three departments: Meats, produce, including fruits and vegetables, and groceries.

"All orders, whether taken over the telephone or by clerks, are written in triplicate on serially numbered blanks, and are turned over to the cashier before being filled. She gives each order a bin number, the serial number being important only so far as accounting is concerned. The bin number, however, is the peg upon which the system hangs. It prevents lost orders and mixed up deliveries, and makes possible a recheck upon every order by the shipping clerk, which has eliminated all my former complaints.

"In alloting bin numbers the cashier begins at one, continues to the highest number, and then repeats. By the time a bin is reassigned, the previous order has usually been removed. After numbering, the telephone clerk, to assist the clerks in filling the orders, identifies those items which will be filled in the meat department by means of a checkmark. A cross, on the other hand, denotes a produce order, while groceries are not marked. This method of dividing the orders by departments relieves the clerk of the necessity of reading the entire order to find the articles wanted from his department.

"If the goods wanted are staples and prices are not subject to change, the cashier fills in the prices and starts the original ticket through the store—grocery clerks pick out the goods in their department, check off the items as they take them from the shelves, mark the packages with the bin number and put them in baskets which are taken to our shipping room at short intervals. (A reproduction of these will be found in Figure 67.)

"The tickets then go to the produce department where the clerks handle them in the same way, and finally they are passed on to our meat department. When the order is complete the tickets are returned to the cashier who foots them, adds the customer's balance, and files them by customers' names."

Reducing the Danger of Delays. How does this speed up the delivery system? Let us suppose that a merchant has installed one of the most effective loading systems which can be devised—one involving the use of demountable bodies (such as is described, for instance, on the next page). An order is received which calls for goods from five different departments of the store or warehouse. The order is sent through the five departments, calling for delivery of the goods at a certain demountable body. The use of demountable bodies saves time in this case, for they can be loaded while the truck is busy somewhere out on the road. Notice, however, that five distinct lines of travel are drawn between the department and this demountable body. This

is for one order only. Another order doubles the number of trips to the body (see Figure 64).

Here is danger of delay, even though a quick-loading device is used, because it may be discovered at the time the truck is about to leave that one or more of the orders is not complete, or that a mistake has been made, necessitating a rechecking of a part or all of the load. It would be strange if mistakes did not occur under such conditions.

The grocer, by use of what might be termed a secondary line of bins, has focused many thin lines into a few single lines. The result is that the demountable bodies, or the trailers, or the truck itself, as the case might be, are loaded without confusion, with small chance of error, and with every opportunity for arranging the units of the load in such a manner as to permit prompt unloading at the various points of delivery.

The principle involved is an exceedingly broad and basic one. Such operations as assembling, weighing, and checking should be performed as far away from the truck as possible. The clerical work should be performed in the store, and not on the loading platform. This may seem obvious, yet more than one big concern loads its trucks by the piece method, weighing and rechecking each piece, while the trucks stand waiting at the dock.

A Plan that Saved $8,700 in a Year. A transportation expert, who took hold of a fleet of 26 trucks belonging to a well-known Chicago wholesaler, tells how, by replanning the entire delivery system, he saved his firm $8,700 in a single year's operation. Beginning with the arrangement of the trucks in the garage, his plans affected every detail of the delivery system, even to the handling of c. o. d. invoices by the drivers. This expert describes his efforts as follows:

"One of the first things I noticed on taking charge was that it took anywhere from ten to thirty minutes every morning to get the trucks out of the garage and lined up at the warehouse. There were 26 trucks and they were housed in a rather long and narrow garage. Half of the trucks were on one side and half on the other, leaving a somewhat narrow lane down the middle. Each truck had to go ahead a few feet, back up again, turn and maneuver several times before it could get out.

"The problem was solved by arranging all the trucks in a diagonal position. (Shown in Figure 65.) Each truck is turned half way in the direction of the exit. This not only widened the path down the middle of the garage, but enabled the truck to start from its position, pass other trucks if need be and go out the exit without backing once. After this plan was tried a few times the entire twenty-six trucks were able to leave the garage in less than two minutes.

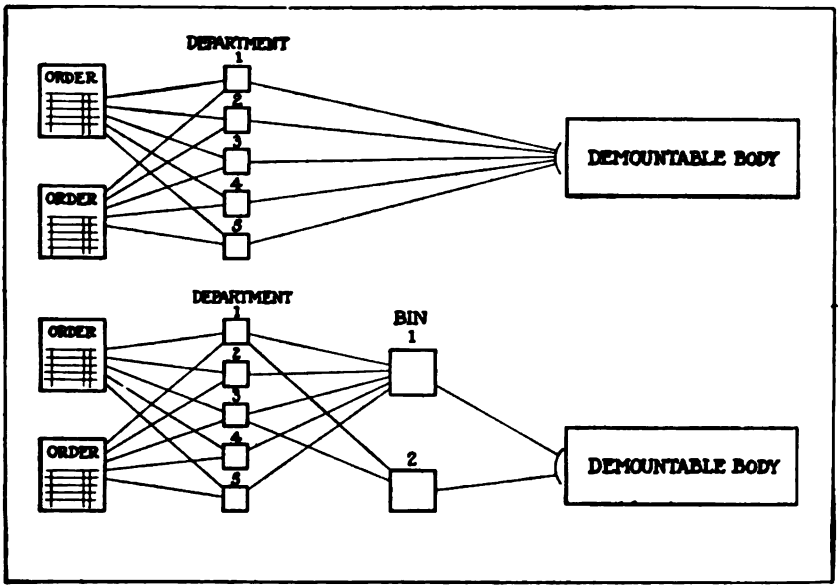


FIGURE 64: Here you have two methods of assembling orders before they reach the truck. In one case the orders are assembled at the tailgate. In the other, bins are used which make it possible to load only complete orders.

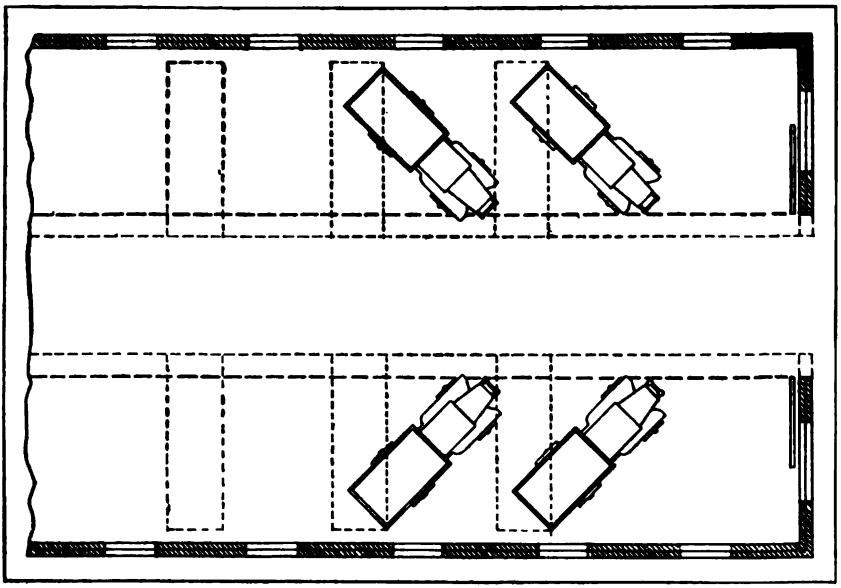


FIGURE 65: This garage was long enough, but not wide enough. The aisle was too narrow, and trucks took a lot of time getting in and out. The problem was solved by placing the trucks diagonally, adding four feet to the aisle.

FIGURE 66: Notice how the body of this industrial truck dips down between the front and rear wheels. Besides giving more carrying room, it facilitates loading because its floor is only a few inches above the ground.

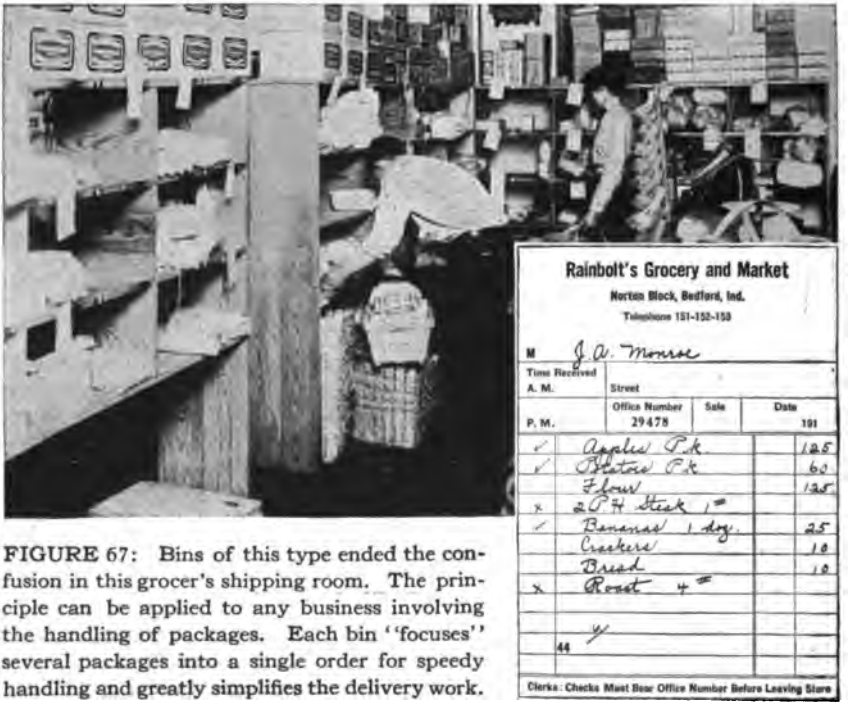


FIGURE 67: Bins of this type ended the confusion in this grocer's shipping room. The principle can be applied to any business involving the handling of packages. Each bin "focuses" several packages into a single order for speedy handling and greatly simplifies the delivery work.

"When the success of the plan was assured, I had broad stripes painted on the floor, indicating the location of each truck, and showing the proper slant or angle at which the truck should be turned. I next instituted a rather strict system or code for getting the trucks started in the morning. At 8 o'clock when the trucks were to leave the garage and report to the warehouse, a first gong was struck. At this signal every driver took his position in front of his truck, with a hand on the cranking handle. At the second gong each driver cranked his truck and mounted his seat. At the third gong the first truck, the one nearest the exit, drove out of the garage. I will explain later in what order the other trucks followed.

"This almost military drill put snap into the day's work where it is most needed: at the beginning. It gave an *esprit de corps* to the drivers, and made them realize that they were part of a big and important system of transportation. But you will wonder how it was possible to get all the drivers together at an appointed hour in the morning without frequent cases of absence or lateness. It would have been impossible if the day's work had started at 8, but the drivers started work at 7:30 and from 7:30 to 8 were employed in other work, which I will explain later. Although some of the drivers failed to report promptly at 7:30, they were generally all on hand before 8 o'clock. This insured the success of the drill.

"I found that the trucks were not leaving the garage in any specified order, neither were they drawing up at the warehouse at any specified place. This of course, caused confusion at both places, but especially at the warehouse where one truck would be held up by another which was blocking its path. I numbered each truck and gave a corresponding number to its space at the warehouse, going up to eight and repeating.

"Truck number 1 had its station nearest the exit of the garage. At the warehouse it had its space *farthest in* from the street. As a result it did not block the path of the trucks which followed later. Truck number 2 came next in line, truck number 3 and so on.

"The warehouse was a little over a block distant from the garage. Between the two places ran a railroad. Here was a danger point. One or two accidents had already occurred at that crossing. I decided that instead of permitting twenty-six drivers to use their own judgment and watchfulness at the crossing it would be worth while to station one man at that point. He kept a lookout for trains and also signaled the trucks at the garage. Truck number 2 would not leave the garage until truck number 1 had crossed the railroad track.

"When the twenty-six trucks report at the same time in the morning for loads special measures must be taken to see that the loads are ready for the trucks. There is no other way of doing this except by assembling the loads the night before. If this requires night work, as I found it did, the fact should be faced cheerfully, and the necessary steps taken to provide an extra shift or to pay overtime to the day clerks. The overtime money paid for night work would rarely amount to more than a fleet of trucks would waste by standing around waiting for loads in the mornings.

"Toward evening work was begun on assembling the loads for the next day. Every order or invoice was marked with a zone number. The order clerks and billing clerks were familiar with the zones which had been established, as I had posted maps of the territory in the shipping room and in the office. By means

of the zone key goods were brought to the proper bin in the shipping department, together with the invoices.

"A special routing clerk took the invoices and sorted them, arranging them with reference to a route, seeing to it that each delivery followed in order, that no ground would have to be covered twice and that no unusually long trips would have to be made for only one or two deliveries.

"Having arranged the invoices in the proper order, he copied the names of the customers off on a tally sheet. The information given was the name of the customer, the street address, and the number of the packages. The original copy was given to the driver, one to the shipping department, and one to the cashier. (Figure 68.)

"Having copied the necessary information from the invoices to the tally sheet the router turned his pile of invoices upside down, and, beginning with the

Tally Sheet

Stop	Name	Address	No. Pkgs.	Amount	Remarks
1	Mrs J. H. Emery	32 Monroe Ave.	2	$1.62	C.O.D. Paid
2	James McCall	39 Towne St	1	$4.25	Not at Home
3	Mrs A. Malloy	146 Harrison St.	3	$11.40	✓
4	John Dunne	198 Towner St.	3	$5.41	✓
5	Edward Barget	161 Newton St.	1	$14.25	✓
6	Ethel Donnelly	225 Greene St	1	$9.50	✓
7					
17					
16					
15					
20					
21					
22					
23					
24					
25					
26					
27					

FIGURE 68: This tally sheet serves not only as a guide for the driver, but also for the shipping room and the accounting department. The names are listed in the order in which they are to be delivered and packages are loaded in reverse order.

last invoice arranged the goods in the bin in the reverse order of deliveries. As a result when the load was swung onto the trucks, the articles to be delivered first would be found near the rear of each machine.

"When the driver starts out in the morning, he takes a copy of the tally sheet and a bundle of invoices. He either hands the tally sheet to the helper or else it is tacked up inside the truck where it can be plainly seen. In any event the driver gives no more thought to it. The bundle of invoices is also turned over to the helper.

"The tally sheet is the chart and compass by which the truck covers its route. It is the helper's job to follow the tally sheet and direct the driver where to go and where to stop. The names of the customers appear in order. This not only indicates the next stop but warns the helper to get his invoices ready and to single out the merchandise to be delivered. Before this system was adopted it often happened that the helper failed to deliver all the packages called for at a given stop. The tally sheet specifies the number of packages.

"In this way the driver was relieved of all duties except that of driving his truck, to which he was able to give his undivided attention. The helper, on the other hand, gave his sole attention to the handling of deliveries. An exception was made in the case of c. o. d. deliveries.

"Many concerns experience difficulties in handling c. o. d.'s, because of the red tape, errors, losses, and thefts involved. I made our drivers instead of our helpers responsible for all such deliveries. To prevent c. o. d.'s being delivered as ordinary orders, a red checkmark was placed on the tally sheet against them. This was the warning signal which told the helper that the next package would have to be delivered by the driver.

"Thus the driver collected all money received during the day and at the end of the trip he added it up and compared it with the sum called for by his tally sheet. He then put all the money in one envelop, sealed it and turned it in. As the drivers often did not return until the store had closed, I provided a special safe with a slot in the top, big enough to receive the c. o. d. envelop. The driver, getting a witness, merely dropped the envelop in, entered the time and the name of the witness on a sheet on the side of the safe, and went home.

"At first I had trouble with the envelops breaking open as they hit the bottom of the safe, but I remedied that by putting in a few layers of burlap.

"In the morning, between 7:30 and 8 o'clock the cashier, who alone had the combination, opened the safe in the presence of the driver and handed the sealed envelop to him. The driver opened it and counted the money in front of the cashier. It was again checked and a receipt given to the driver.

"Not only was the firm protected by this plan, but the driver as well. As a result c. o. d.'s were no longer shied at by the driver but were delivered as willingly and promptly as ordinary deliveries.

"Nothing was more annoying to us than to find out that a special order had just missed connections with the proper truck by a few minutes. This happens in many stores and not only creates dissatisfaction in the mind of the customer if the order is not promptly delivered, but causes an inordinate expense if a special trip is made to deliver it.

"Accordingly, I arranged a system of electric bells which rang in the warehouse and also in the office. Five minutes before a truck left to cover a certain zone a signal was sounded on the bell. This warned the shippers, and the order takers as well, that a truck covering Zone 4, for instance, was about to leave. They at once looked over their invoices and orders, and gave preference to any 'specials' for that zone which might have come in the last few moments."

In this chapter we have considered specific methods by which truck owners in various kinds of business have organized and speeded up their delivery systems inside the store. We have

discussed chiefly the clerical means by which orders are made into loads and loads are made ready for the truck. We have taken you, as it were, to the edge of the loading platform.

And here we find a great number of devices which enable the owner to deposit the load upon the waiting truck, often in a fraction of a minute. These devices are very important, because they help to cut down the most serious delay met with in truck operation. What are these devices, and how can they be used to speed up the delivery of goods by motor truck?

CHAPTER VIII

DEVICES THAT REDUCE LOADING TIME

THE statement "Trucks that work are trucks that pay" has now become a commonplace. One does not need to be much of a mathematician to figure out that the truck, which costs three or four times as much as the horse-drawn unit, is wasting time by standing idle. And this is three or four times as valuable as that lost by a horse and wagon. Conversely, it is true that the motor truck coming into the field dominated by horse standards can, by proper attention to the elimination of idle time, earn profits many times larger than are realized from horse equipment.

One Case of "Speeding Up" that Failed. It may be well to give here the experience of a merchant who attempted to speed up the loading of his horse-drawn wagons. He had been approached by truck salesmen who had talked to him regarding the efficiency of motor trucks. He listened to their stories and got the idea that truck efficiency was largely a matter of installing auxiliary devices, and, accordingly, he attempted to do the same thing to his horse delivery system. He speeded up his loading arrangements so that the horses were practically always on the move. The scheme had not been in operation four days, however, before he began to receive complaints from his drivers. The horses, they said, were all fagged out on the second day, and on the third day one of them collapsed on the street. The merchant was not long in discovering that machines of flesh and blood are not like those of iron and steel. The old system of leisurely loading is well suited to the horse, in fact it is necessary to his health. The merchant saw the force of the situation, and having made a start toward efficiency by installing quick-loading devices, he completed the step by installing trucks which alone could take advantage of them.

Unquestionably the longest delays to which a truck is subjected occur at the loading point, whether this point be the shipper's platform which is subject to the control of the truck owner or whether it be the distant freight station over which he is likely to have no control. Just as it is more difficult to build up than it is to tear down, so also it is generally harder to load than to unload. It behooves the business man, therefore, who is responsible for the efficient operation of motor trucks to give special attention to the matter of facilities for loading, for speed in this process affects to a very large extent the profits to be derived from motor truck transportation. Since the introduction of motor trucks a great many ingenious devices have been perfected to speed up loading. All of the representative types of loading devices are presented in the following pages of this chapter, and the merchant will do well to examine them closely, for it is likely that he can make use of more than one of them in one form or another in his business.

Devices that Shorten Loading Time. By the installation of an automatic wagon loader, an Ohio contractor has reduced the loading time of his truck from six to three minutes. This was only a saving of three minutes per load, which would not have been of any consequence were it not for the fact that the truck made 40 trips per day. The saving of three minutes was, therefore, multiplied by forty, showing the total saving of time of two hours per day, which, in view of the conditions and terms under which the truck was operating, increased the daily profits from this truck about $8.

Perhaps one of the most effective loading devices is the demountable body or some modification of the demountable principle. The working out of this idea is indeed simple. Two bodies are constructed for each truck. These bodies are interchangeable, in fact, indentical with each other. While the truck is out making a delivery with one body, the second body is held at the plant and loaded. It is not necessary to speed up unduly the course of loading, for this may be done carefully and deliberately, inasmuch as plenty of time is generally available before the truck returns for its load.

The most elaborate feature in such an installation is the chain-falls required for suspending the truck body at the shipping dock as shown in Figure 73. It is obvious, of course, that the body must be held high enough above the ground to permit

the truck chassis to run under it, and that means must be provided for lowering the loaded body onto the truck. Such apparatus, however, is not expensive, and can generally be installed without difficulty at a shipping dock.

Demountable Bodies as Time Savers. A striking instance of the economy of this manner of loading is that employed by The Curtis Publishing Company of Philadelphia. By use of demountable bodies in connection with four trucks, this well-known company made a gain of 14 tons a day in haulage, the work consisting in hauling mail bags from their plant to the Pennsylvania Station. The method is as follows:

At the beginning of each day's work, four of the bodies are hung up at the loading platform at the plant, and all of the trucks are at the garage. Four-wheeled hand trucks of 1 to 1½ tons capacity are used to convey the mail bags from the post office checkers on the wrapping floor to the loading platform. Iron bridges between the platform edge and the tailboards of the suspended bodies permit the hand trucks to be rolled directly into the bodies. In this manner the truck bodies are quickly and easily loaded, and trucks to haul them away are dispatched from the garage. Before they report to the shipping platform, they proceed to the warehouse, where each picks up a load of paper rolls. These are transferred to the courtyard of the main plant. The paper is taken off, and the empty truck backs into the loading bay—directly under the loaded body to which it has been assigned. After it has been backed into position, the platform men lower the body onto it and detach the supporting chains. An official of the Curtis Company stated that the bodies cost but $165 each. He figured it would take six trucks with permanent bodies to do the work that four trucks with six removable bodies do, so that the arrangement saved the cost of two chassis outright, the extra substitute bodies costing but $330. To this must be added the cost of the chain-falls used to raise and lower them, and tracks upon which they travel.

How Trailers Save Loading Time. Closely related to the demountable body is the trailer, which may be considered as a demountable or removable body on wheels, but, instead of being superimposed on the truck chassis, it is trailed behind it. Trailers are every bit as serviceable as demountable bodies; they may be left at loading docks, they may be moved about as well on their own wheels as demountable bodies can on special

overhead tracks, and their slightly additional cost over demountable bodies is easily offset by their greater carrying capacity and the fact that they do not require chain-falls and overhead tracks. The trailer may, therefore, be listed among the most important devices for eliminating delays at the point of loading, although it should be noted that this is by no means the chief claim which trailer manufacturers advance in their favor. We shall consider their other advantages more fully in Chapter XI.

Another Form of Demountable Body. A device which is really a demountable body in disguise, shown in Figure 69, is used in a Los Angeles lumber yard. While the truck is out delivering, a hand truck is pushed round the yard and the next order is assembled on it. When all is assembled, the hand truck is run under a traveling crane, and the load is hoisted from the hand truck by chains which are fastened to two iron bars. This load is now elevated to such a height that the truck can be readly backed under it, and when this is done the load is released and the driver is ready to take the road again.

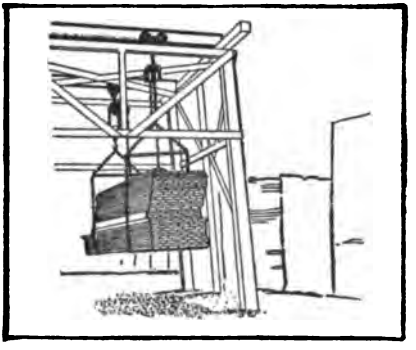


FIGURE 69

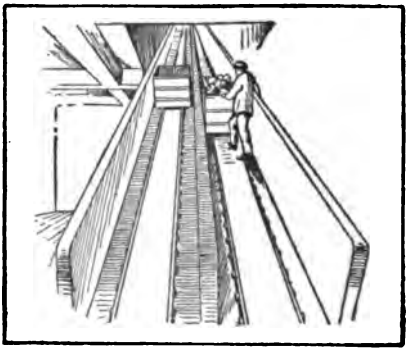


FIGURE 70

This is really the principle of the demountable body used again, but owing to the character of the load an actual body can be dispensed with. It would be quite different, for instance, if the load consisted of some bundles of shingles, a few kegs of nails, clapboards, and rolls of tar paper. Its simplicity, however, is all the more reason why it should be used.

How a Lumber "Dolly" Helps. Another way of loading lumber is by the use of a "dolly" in connection with a roller lying horizontally on the truck chassis near the rear end. It is interesting to follow the progress of loading lumber on trucks,

as it is done by this method from the receipt of the order to the moment when the truck leaves the yard bound for its destination. The lumber "dolly" which is a simple two-wheeled cart having hinged supports at one end is rolled about the yard by hand while the different boards and timbers are selected. When the load is completed, the "dolly" is moved to a position awaiting the arrival of the truck, and the supports at the end are dropped so that they reach the ground, holding the boards in a horizontal position. The supports are of such length that they enable the truck to back under the end of the load. The props are then removed, bringing the lumber down upon the horizontal roller located on the chassis. It is then possible, by turning the roller with a crank, to transfer the entire load of lumber from the "dolly" to the truck. The "dolly" of course is also equipped with a roller, and this can be operated at the same time, to assist the moving of the load, or it can merely serve as an idler to lessen the resistance while the roller on the truck does the work. (Figure 74.)

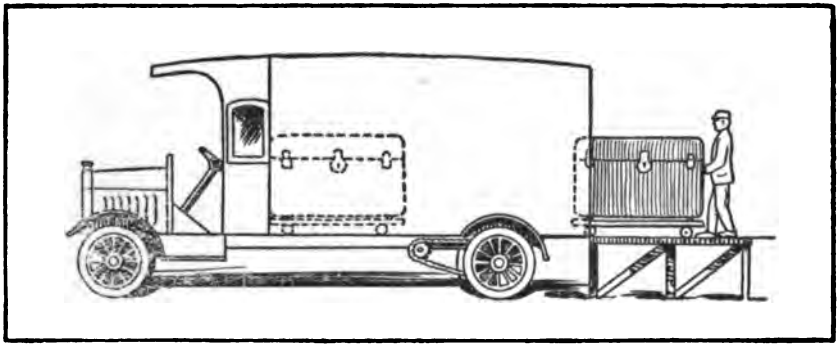


FIGURE 71: Individual trunks or hampers when used as shown here form another type of demountable body which possesses many advantages for certain kinds of business. The bins are relatively light and are mounted on casters.

The "Nest" Body. A direct modification of the demountable body is the nest body, which has been likened to a sectional book case. (Figure 75.) This is really a skeleton for use inside the regular fixed body of the truck. The nest body is divided into divisions, each one capable of receiving a uniform bin or section. These sections are loaded at different parts of the store and brought by suitable means to the nest, into which they are loaded. The nest or skeleton is then ready to be rolled upon the body of the truck when it backs up for its load.

Sometimes the total nest body is divided into a number of sections, so that they may be more easily rolled upon the truck than would one larger one. This is advisable where the material handled is heavy.

When Trunks or Bins May Help. Still another modification of the demountable body is found in the use of individual trunks or bins, sometimes called hampers. (Figure 71.) These trunks are made of good fiber, and last a long time. They are packed according to the route throughout the store and sent to the delivering room. Here they are checked and then locked or sealed. This overcomes the necessity of checking goods, at the time of loading on the truck, which is such a common cause of delay in even large shipping departments. These trunks are relatively light, and can be wheeled about on their own casters, and readily rolled upon the truck when it arrives.

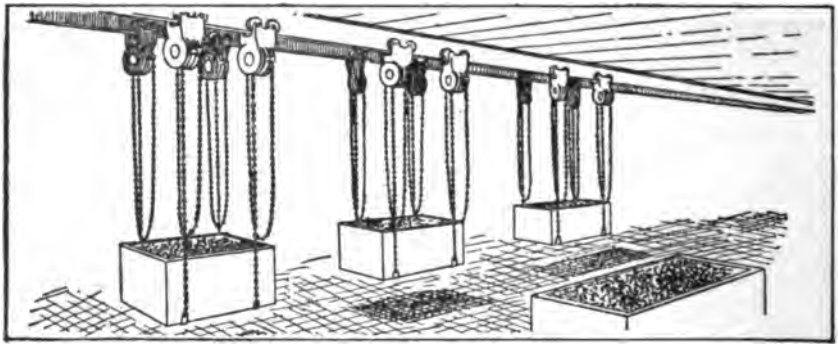


FIGURE 72: By means of this telpherage system of overhead tracks, shipments, both bulk and in packages, can be carried speedily from points in distant parts of a store or warehouse, direct to the truck, often reducing loading expense 50%.

In connection with handling these individual trunks or containers, a telpherage system (Figure 72), that is, a system of overhead tracks often becomes imperative. By such means these hampers can be whisked about from department to department of the store until they are filled, and then delivered where they will be needed for loading.

The principle underlying all this is clear. A container is provided, in which to assemble the various units of a shipment, whether it be an entire demountable body, a nest body, or good-sized trunks or hampers. Checking and rechecking is done at the time of assembling. The containers are locked or sealed.

FIGURE 73: Note the chains and pulleys overhead—a chain-falls, in fact, by means of which the already loaded body is being lowered on the chassis. The body is demountable and greatly increases the actual working hours of the truck.

FIGURE 74: While the truck was out on the road making deliveries, the lumber "dolly" was pushed round the yard and loaded. The man is turning a roller, which transfers the entire load of lumber onto the truck.

FIGURE 75: Here we have "nest" bodies fitted inside of a stake or platform body. That's what these balls of yarn are being packed in. The nest bodies are loaded while the truck is busy with another delivery.

FIGURE 76: The industrial truck has been called the "handmaiden of the motor truck." These little carriers are often efficient loaders, bustling about through a manufacturing plant, or bringing material from freight cars direct to the dock.

FIGURE 77: This truck is standing still, but its engine is working to advantage, for it is operating a winch and hauling a heavy reel of cable up onto the body of the truck. It is the work of but a few minutes.

FIGURE 78: If you have loose material to load, and cannot always put it in a hopper and discharge it from an overhead chute, a loader of this type may solve your problem and prove much cheaper than shovels used by laborers.

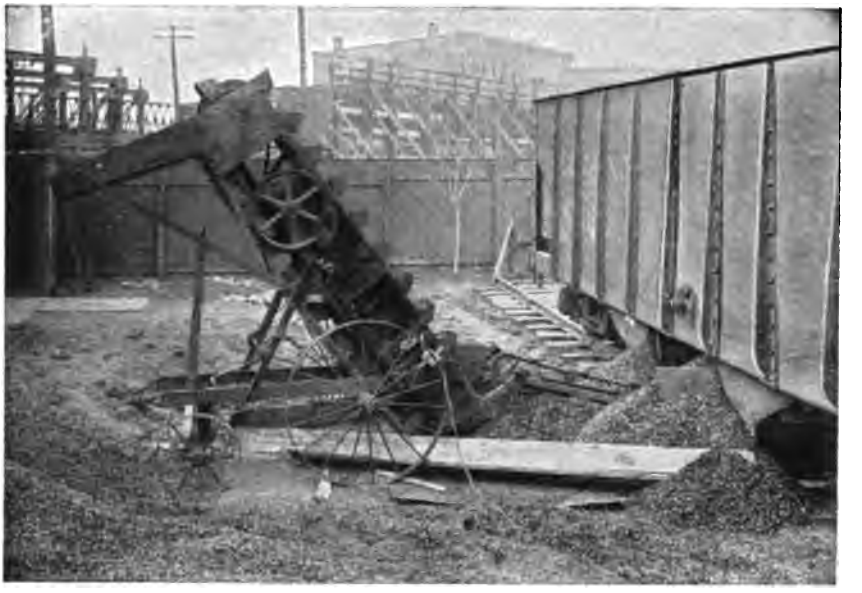


FIGURE 79: While this machine is styled an unloader, it is a loader as well. The freight car has the gravity pitch built in, which makes it possible for this device to load the truck as it unloads the car.

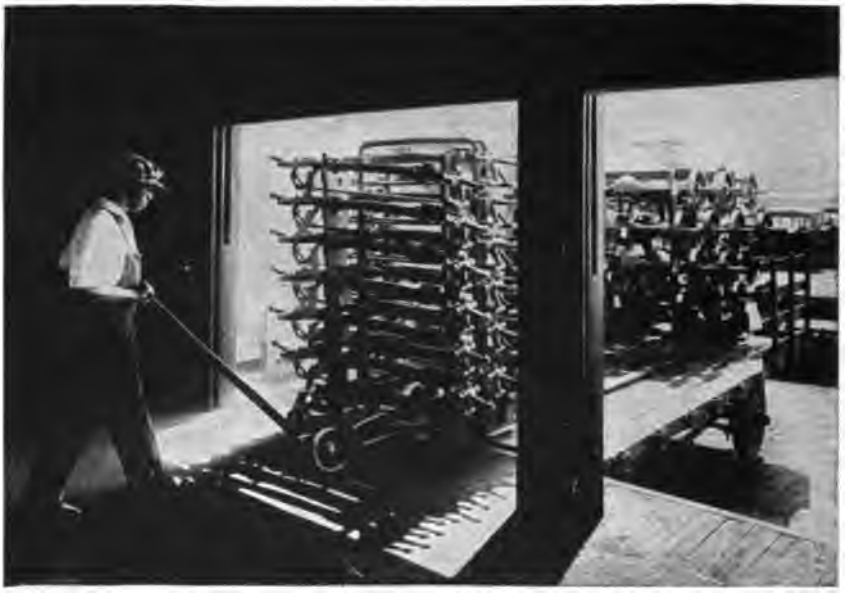


FIGURE 80: This automobile manufacturer found it worth while to build special "trees" which are platforms with stake sides. Each "tree" holds seven axles. The "trees" are hauled by industrial trucks.

Then, when the truck backs up, the load is moved on. Despite the simplicity of this well-known device, many large concerns are still loading their trucks piece by piece, checking and weighing each piece at the moment of loading, and thereby holding up their trucks an unnecessary length of time.

In the dry goods business, and others involving the handling of many small units, proper machinery must be set up in the shipping room to cause an endless flow or current in the great

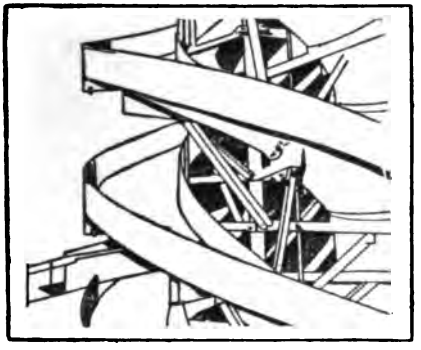


FIGURE 81

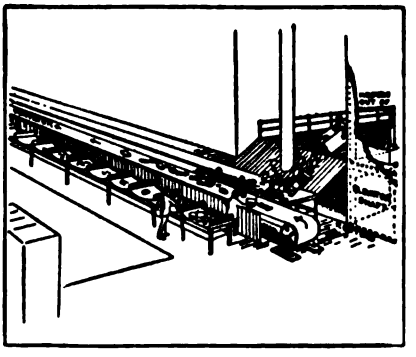


FIGURE 82

mass of merchandise. Most of this is familiar to all who have taken a peep at the workings of department stores, so that a brief mention will suffice.

Moving Stairways for Loading. Escalators (Figure 70), which are moving stairways for freight, are indispensable in most department stores, although for heavy merchandise the elevator must still be used. Perhaps the greatest agent in the quick handling of small packages is the spiral gravity chute (Figure 81). The effectiveness of such chutes is increased by making them multiple-decked. In one New York department store there are three of these chutes running down through the building, one at the west end, one at the center, and one at the east.

Each of these chutes is triple-decked and lettered A, B, and C. Thus a clerk on any floor having material near any one of these chutes can dispatch it according to the desired classification to any of the three divisions of the shipping department.

Belt Conveyors. Working hand in hand with the spiral chutes are the belt conveyors (Figure 82). These are broad belts which carry articles horizontally across the store. Their office is to pick up the articles as they whiz from the chute, and convey

them in a semileisurely manner before the eyes of sorters, routers, and other clerks, who give them their final disposition.

One other agent is indispensable, that is the floor truck. Often material must be moved for which the belt conveyor or the telpher is not suited. Little roller boxes are here used. Where material is heavy or bulky, large hand trucks running on four wheels are necessary, and they often have a capacity up to 1¾ tons.

Then again where lifting as well as carrying is essential, hand-lifting trucks are employed, which are also able to elevate the load—an elevator mounted on a hand truck, they might well be called—and they expedite marvelously the handling of heavy material. (Figure 83.)

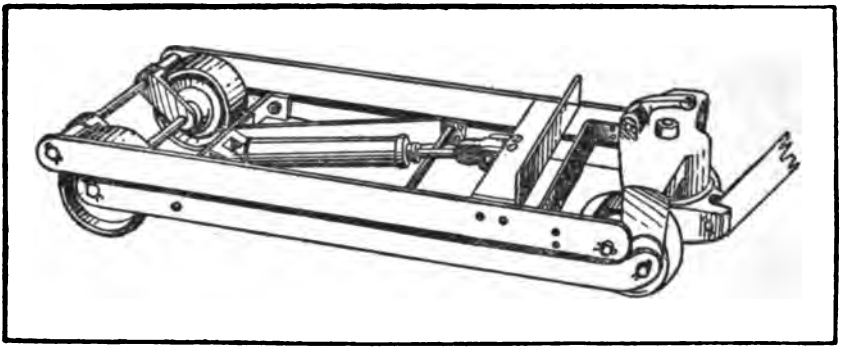


FIGURE 83: This hand truck is slipped under a loaded body which stands high enough above the floor to accommodate it. The lever is pressed and the hand truck makes away with the load with little effort.

Lastly, to meet the final test, an actual power-driven truck is introduced, the doughty little industrial, having a carrying capacity up to two tons, which negotiates the abrupt grades often met with in moving material at docks or terminals, and which on level floors draws long trains of hand trucks hitched together. These industrials are so compact in size and so powerful that they run right into freight cars, where they pick up heavy loads and carry them directly to the waiting truck.

Roller Gravity Conveyors. For loading small and uniform units upon trucks where the nest body or trunk system is not applicable, a device called a roller gravity conveyor is used. (Figure 88.) This is made long enough so that it reaches from the shipping dock to a point just behind the driver's seat, and

FIGURE 84: This concern has found it worth while to install a permanent overhead crane, because it has occasion daily to load heavy pieces of metal. As it did not have enough heavy loading to install power, it is operated by hand.

FIGURE 85: Notice at the right of the illustration the chain buckets; the revolving barrel with fine and coarse mesh and the huge pen with separate chutes each of which discharges a certain size of crushed stone into the truck.

FIGURE 86: On this page are two views of the lowering device referred to in this chapter. It is operated by gravity with gears and brake levers to control the speed. Where there is a large amount of loading they help greatly in speeding up.

FIGURE 87: In the shipping room this device automatically discharges its loads upon chutes, where they are assembled for transfer to the truck. By its use a New York wholesaler assembled a 6-ton load from five floors in 35 minutes.

when the forward end of the truck has been packed, the conveyor is withdrawn a corresponding distance. Thus it is adapted to packing the truck at all depths, and the shipper does not have to carry the material any farther than to the edge of the dock.

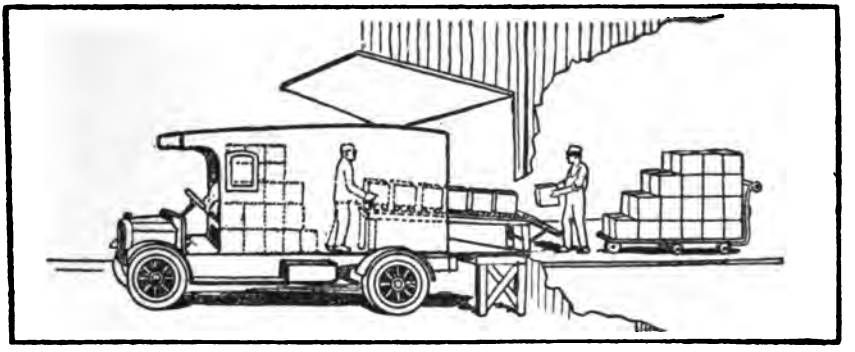


FIGURE 88: This gravity conveyor bridges the distance from the edge of the shipping platform to a point directly behind the driver's seat. It may be used for loading or unloading. A hand truck is usually stationed at the platform end.

The Power Winch. For loading very heavy and rough material, devices of a different order are required. One of the most important of these is the power winch. (Figure 77.) This may be situated at any point on the chassis, and is operated by the motor of the truck itself with a suitable reduction of gears. A long cable is used in connection, by means of which any object of a size approximately the capacity of the truck can be hauled bodily upon it. This winch is also of use in extricating the truck when mired.

Another loading device, separate from the truck, used for lifting heavy material, is the portable crane. (Figure 89.) This machine easily and quickly will negotiate heavy, bulky loads, such as granite slabs, castings, or machinery, which many men could scarcely move or lift.

Dealers in coal and crushed stone usually provide themselves with overhead gravity chutes from which to load their trucks. It sometlmes happens, however, that a quantity of such material has to be loaded from a pile that lies on the ground, where no arrangement such as a gravity chute can be set up. To expedite such loading, a device has been made of which we present an illustration in Figure 78. This device has the dual advantage of being portable, and at the same time can be set up without much trouble most anywhere.

The device just described is adapted to loading material which lies in a pile. Quite a common condition, however, is the necessity of loading from freight cars. These cars are generally designed with gravity pitch built in, and deliver material through

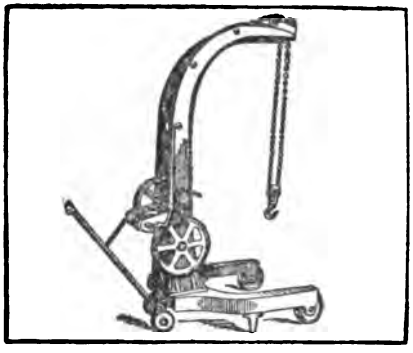


FIGURE 89

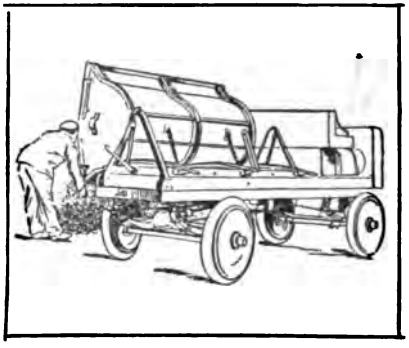


FIGURE 90

the bottom. To handle such a condition, an unloader has been devised. (Figure 79.) It will be noted that, although this device has been styled an unloader, it is also a loader as well, what it unloads being only the freight car. Some cars of older construction, however, have no such provision for unloading their contents, and the material has to be delivered over the sides. To take care of this, a simple device has been invented, styled a tip bucket loader, which, briefly described, is a tip-bucket mounted on struts, which are extensible and make it possible to elevate the bucket to any height, according to the height of the freight car at which it is being used. (Figure 93.)

How One Concern Simplified Loading. How an automobile manufacturer solved the problem of shipping assembled rear axles is shown in Figure 80. The concern in question found it worth while to build special "trees" which were nothing more nor less than platforms with stake sides. Each "tree" has a capacity for holding seven axles. Moreover, the "trees" were in such shape that they could be readily used in connection with industrial or floor trucks. This efficient system was carried out from the point where the axles started their journey, that is, the machine room. The axles were mounted directly onto the "trees" which were brought up beside the work-floor trucks or run under the "trees," picking them up and transporting them to a large doorway, where they were picked up, this time by an

overhead crane which swung them out over the street and into the waiting trucks below. This method of packing has still another advantage in that there is but little chance for any of the assembled axles to become damaged by rubbing or chafing each other while on the road, as would be the case if this same number were piled indiscriminately on the truck.

The Traveling Crane. A brewer installed a novel loading device on his truck which enabled him to hoist a 63-gallon barrel from the ground and place it on any part of his trucks within the space of one minute. He utilized the principle of the traveling crane, which generally is associated with large machine shops. The crane is designed to travel on overhead tracks running lengthwise, and the entire mechanism can be controlled with one hand, as all the switches are conveniently placed in a unit on the crane. This device is also adapted to the use of millers, hay and grain dealers, and others who handle heavy loads in packages. (Figure 84.)

Sometimes difficult loading problems are solved by the very simplest expedients. A glass manufacturer in St. Louis delayed purchasing trucks because he could not find one which met his peculiar needs. He required a truck having a platform height of sixteen inches, which was the height of his horse-drawn drays and for which his loading platform had been designed. It was several months before someone suggested that he scoop out the driveway beside his loading platform to a depth of a foot and a half. He did this and bought trucks. The solution of his difficulties was as complete as it was simple.

A Gravity Lowering Device. It frequently happens that assembling an order for trucks involves collecting it from stock carried on floors above the shipping room. In such cases delays in loading may occur because freight elevators are used which cannot be hurried and are apt to be loaded with goods going up when they are needed to take some down. An ingenious automatic lowering device has been invented for hastening and simplifying the downward movement of such goods.

In principle the device is merely a series of platforms traveling on an endless chain downward in a shaft. It requires no operator nor any power, as the platforms are lowered by gravity. Each floor man merely takes his part of the order and places it on the cars as they pass his floor. (Figure 86.) The articles are quickly lowered to the shipping room where they are auto-

matically discharged upon receiving chutes (Figure 87) and moved to the waiting truck or demountable body.

Wholesale grocers and druggists, hardware jobbers, and others handling goods in more or less bulky packages have found the device helpful in speeding up assembly of orders where it is necessary to secure items from different floors.

We have not attempted to describe in this chapter every known device for increasing the efficiency of loading motor trucks. Those mentioned, however, embrace the fundamental or basic principles of loading, which may be modified in a great variety of ways so as to meet the needs of any individual installation.

CHAPTER IX

EFFECTIVE SCHEDULING AND ROUTING

HOW shall the truck operator determine the routes which his trucks must travel? How shall he lay his plans for dividing up the territory which his trucks must serve—territory that may extend ten, twenty, or fifty miles in every direction from his central store? Where shall his trucks go, and at what intervals?

These are large problems, and require planning of the highest order. The truck owner who is installing a system of operation for a fleet of trucks is in a position not unlike that of the railroad builder. He must, so to speak, lay down tracks over which his business shall travel, routes which will become more or less fixed and will determine in a large measure the amount of profit his transportation system will return. Like the railroad man, he must consider distance, density of traffic, mechanical obstructions, costs per mile and per ton-mile, possible future returns, schedules, performance, and a dozen other factors. He must assemble them and reason out the right course of action.

The Basis of a Delivery System. Face to face with such difficulties, how shall the truck owner go about solving the problem? It will help greatly if he will bear in mind from the start this fundamental fact—the zone is the basis of the delivery system. Let him design his zones correctly, and the delivery system which he erects upon them will have small chance of failing.

In Chapter VII we learned that scarcely is an order received over the counter or the telephone than it becomes necessary to know the zone in which the future delivery lies. In fact, that part of the delivery system which may be said to be contained inside the store or the warehouse hangs upon the zone number as upon a peg. The bins are numbered with the zone numbers

or the demountable bodies, hampers or trunks, and the same number appears on the invoices, the shipping tickets and the tally sheets. The routing of the packages is determined with reference to the well-known design or "appearance" of the zone, and thus facts which may have been acquired at great pains and expense are made daily use of by the routing clerk.

Outside the store the zone is no less important. A fixed zone means that the driver becomes familiar with his route and can do it, as the saying is, "with his eyes shut." Moreover, without the zone, it would be impossible to figure on the probable time of deliveries. Thus scheduling would disappear, the dispatcher on the loading platform would not know what load to get ready next, or what truck to count upon, trucks would return and find no work to do, or be obliged to carry away a half load, or perhaps again an overload. Moreover, without the zone, costs of delivery could not be figured for special jobs.

As an example of this last point, a certain oil company in a western city charted out the zones or routes covered by their various trucks, and analyzed and applied their costs against each route. Out of twenty-two routes they found that six outlying ones were unprofitable. These they quietly dropped off into the hands of a competitor.

How a Zone Should be Planned. It may take anywhere from a week to several months to lay out a satisfactory zone of delivery. Many things must be considered before a decision can be safely reached. But the time is well spent, for a well-designed delivery route, one which is symmetrical, serves the largest number of customers with the least idle time, makes use of the shortest cuts, and does not cover the same ground twice. Such a route is as much an asset as the truck that covers it.

The first step in planning an efficient delivery zone is to secure a map of the territory covered. This map should be as large in scale as can be secured, showing all the streets, roads, bridges, toll gates, docks, ferries, and so on, with as much detail as possible. This map should be tacked up on the wall in plain sight and never taken down. It should be constantly studied. It is the guide for present routes and the inspiration for new ones.

How a City Map Changed One System. A large Chicago supply house uses six heavy trucks for delivery to its customers in various parts of the city. Formerly, as customers telephoned their needs, a load was assembled, and a truck was sent out.

The result was a heavy delivery cost; stops were far apart; frequently two trucks were dispatched to the same general neighborhood. Mileage ran high and service was poor. The only way to catch up with the selling seemed to be the purchase of more equipment, which might mean still higher costs.

At this juncture, the superintendent brought his analytical ability to bear. With his assistant, he prepared a map of the city, on which the location of each customer was indicated by a small tack. The shortest road to each general section of the city was marked out, and then, considering the density of trade, the city was divided into eight delivery sections, each covering the amount possible for the truck to make in half a day. When stops were frequent, the areas of the route sections were proportionately smaller.

The business district bounded by Halsted Street, Chicago Avenue, Twelfth Street, and the lake (about three square miles) was reserved for teams; and the deliveries not included in any of the eight route districts were given to express companies. In dividing up the city, attention was paid to available routes as well as to density of customers. Chicago has a number of diagonal streets which are available as short cuts, and the routes were planned to take advantage of these.

At the time the routing and scheduling system was put into effect, the scheme was outlined to the customers. Some opposition developed of course. The contractor who was accustomed to telephone in an order to fill a minor need required time to adjust his methods to the new system. But now, after two years, the plan is working to the satisfaction of customers and house. When an emergency arises, it is met by a special trip—but this seldom occurs. The customers know the time of day at which deliveries are made. They order accordingly, and they are always sure that the goods will be at the store on schedule time —for the customer as well as the delivery manager, accuracy and promptness spell satisfaction.

Time Studies Supplement the Map. But the map, properly considered, is only a background. It is the special information which is placed on it or used in connection with it, that makes the map valuable in planning delivery zones. While the map gives distance, another factor must be known. That is time.

In actual practice, delivery zones are developed by experiments. It is seldom possible to lay down a perfect route the

first time. With the aid of the map and the scale of distances, the location and number of customers to be served, a preliminary zone is outlined. But the test of the zone is the time study. In fact the time study is to the route what the scale is to the map, namely, a means of measurement, dealing not in miles, but in idle time, loading time and time spent in stops. How this information can be made use of not only in reshaping routes, but in choosing the right delivery equipment, number of helpers, and so forth, is illustrated by the following example:

Analyzing Routes by Time Studies. The time study was by means of a long stick, equipped with slides of five different colors—tacks would have served just as well—each slide representing five minutes. Each brown slide represented five minutes spent in loading, each white slide five minutes in traveling at full speed, each gray slide five minutes at half or reduced speed, each green slide five minutes in unloading, each black slide any other delay. Remember that these slides represented time and not distance. Where distance is involved, it can easily be calculated from the speed of the truck. Refer to the chart on the next page, and let the merchant tell the story in his own words:

"I drew out each delivery route in a straight line. Laying my yardstick beside it, I measured it in units of time consumed. I got some mighty interesting results.

"Route A, for instance, caused me a lot of disappointment. Here was a trip involving a fairly long haul, and yet the white spaces, the 'open running,' showed only a bare 25% of the trip. Because of the character of this load an excessive amount of time was spent unloading. Only four stops were made, yet they consumed 65% of the time. Several possibilities suggested themselves to me. First, by the use of a demountable body I could cut the loading time down to 1%. This would have been a saving of only 9%, and might not have warranted the investment in the extra body. Moreover, the saving of 9% might be represented by an increase of only 3% or 4% in the actual running time.

"A second possibility was the use of a trailer. With the trailer I could hitch up after the loading was all completed and speed out to my first stopping place. What should I do then? If I sent the truck back, how should I move my load to the second stopping place? The distance between stops was very short, but, however short, the vehicle could not be moved by hand. I would either have to make a second trip with the truck—in fact, three or four trips, which would be out of the question—or else leave the truck there, in which case I would be in the same position as if I used a truck alone.

"A third possibility suggested itself. Why not station a horse at the first delivery point, to take up the work of moving the load on to the three remaining stops? I found this would not pay, as, in addition to the motor service, it

would be tying up a horse all day, and it would have been expensive to maintain a horse so far away from my stable base.

"A fourth possibility was to add another helper to the crew of the truck, and thus cut down the delivery time. However, that would add an extra item of labor, the expense of which would very nearly equal the saving in time. How I solved the problem will appear later.

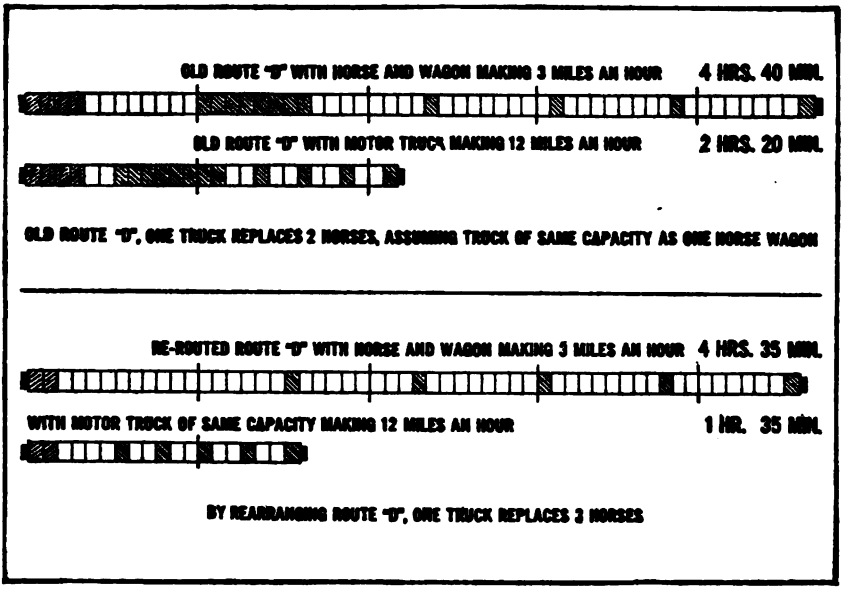

OLD ROUTE "B" WITH HORSE AND WAGON MAKING 3 MILES AN HOUR
4 HRS. 40 MIN.
OLD ROUTE "B" WITH MOTOR TRUCK MAKING 12 MILES AN HOUR
2 HRS. 20 MIN.
OLD ROUTE "B", ONE TRUCK REPLACES 2 HORSES, ASSUMING TRUCK OF SAME CAPACITY AS ONE HORSE WAGON
RE-ROUTED ROUTE "B" WITH HORSE AND WAGON MAKING 3 MILES AN HOUR
4 HRS. 35 MIN.
WITH MOTOR TRUCK OF SAME CAPACITY MAKING 12 MILES AN HOUR
1 HR. 35 MIN.
BY REARRANGING ROUTE "B", ONE TRUCK REPLACES 3 HORSES

FIGURE 90-A: The routing of trucks is often all-important, especially when long stops are included. Note how this truck's old route, as shown at the top, has been changed to eliminate a long stop. It is fully explained in this chapter.

"Route B showed up like a winner from the start. My partner had always told me this route would not do for a truck, because there were so many stops on it. My analysis, however, showed that these stops, although numerous, were of short duration, averaging two and a half minutes each, and the distance between was considerable, giving the truck plenty of opportunity to show its fleet heels. The white spaces, representing open running, showed up strong. In fact, 75% of the time the truck was making its twelve miles an hour. I put this route down for a truck at once.

"Route C was of quite another character. Although the time spent in loading was not excessive, and the stops were of as short duration as in Route A, these stops were very close together. Thus, the total time spent at stops bore a high proportion to the time spent running. Moreover, the actual running time showed up a muddy gray on my yardstick, being five or six miles an hour. This was due to two factors: first, the route lay through a congested part of the city; and second, the distance between stops was so short that the truck hardly had time to get up speed before it had to slow down again. Old Dobbin

has this route to this day, and I do not see any way of ever making profitable use of a truck on it.

"Route D is one of my pets. When I first laid my yardstick on this route the 'white spaces' showed only a scant 32%. The indication, of course, was that right here was another good place to stick to the horse. This route was peculiar in that the first stop consumed nearly 25% of the time. This stop was at a large apartment block and was about half a mile out from the store. Following this stop the route took on the general character of Route B—that is, there were several short stops separated by a lot of open running. (Figure 90-A.)

"A happy thought came to me: I would eliminate the first stop altogether from the route. As this stop was such a short distance from the store, a horse could make it economically, and certainly could much better afford to stand around half the morning than my high-priced motor truck. Route D, as altered, is now as huge a success by motor truck as Route B—which it now resembles—and the time gained by eliminating this big first stop has been used to good advantage by extending the radius and bringing in new business.

"Route E is another disappointment. It is very much like Route D which I have just discussed; it is ruined by one long delay. You will probably say at once, 'Why not eliminate this delay and turn it over to the horse, as in D?' There happens to be a very good reason why this cannot be done. This delay occurs near the end of the route, and is a long way from the store. In other words, to turn it over to the horse would involve a long haul, a condition which is practically always unfavorable to the horse. In D it was just the other way. The big delay occurred only five blocks from the store. A horse was able to reach it in ten minutes.

"I have, however, speeded up the work of loading and have cut down the time of delivery so that the white spaces show 50%. Under such conditions I find a truck profitable, although not so profitable as in Routes B and D.

"Route F is another one of my favorites. The yardstick at first showed this trip to be one of the worst of the lot. While there was a clear haul of several miles, a large amount of time was spent in loading and still more time in delivering. The delivery was made to two places, one taking seven-eighths of the load, and a dealer located half a mile farther on took the remainder.

"There were two delays to be eliminated. The first was the one of loading. This could be reduced to almost nothing by using a demountable body or a trailer. The second delay, that of delivering, could be solved only by a trailer.

"The trailer was loaded while the truck was otherwise employed. Thus the delay at the loading station was reduced to the time necessary to couple it to the trailer. The truck hauled the trailer to the delivering point at full speed and immediately uncoupled.

"The truck now might have been sent back to the store at top speed. However, as luck would have it, Route A was not far distant. Here you will remember I was in a quandary to know how to move the uncoupled wagon the short distance separating the three places of delivery. I sent the truck across country and used it for that very purpose. By the time the truck had arrived, the first of the three deliveries had been made and only two more remained. The truck driver doubled the labor by becoming a helper for the moment, and thus the time of making these two deliveries was shortened by half. Not only that—when this trailer was emptied the truck coupled up to it and took it back

across country to where the first trailer was just completing the delivery of its huge load. This trailer was also coupled on and the train proceeded on half a mile to where the small balance of the load had to be delivered. Then the truck headed for the store at full speed.

"Originally I had twenty horses. I now have disposed of eighteen of the horses and fifteen wagons. I have kept two horses, one for Route C, and the other for odd hauling jobs where it would not pay to send a truck. I have reduced my hauling bill 40%, and have lengthened practically all my routes, bringing in new business which I could not profitably reach before."

Developing Ideas Gathered from Time Studies. When the truck owner has acquired, mainly by special observation, dependable figures on the time required to cover a given route, or the distance between important points on a given route, he is in a position to do further planning and arranging of his zones which will increase their effectiveness. Thus he may decide that a certain truck should make two trips per day. It becomes necessary at once to plan the route in such a manner that the truck leaving at 7:30 will complete its trip by 12, and, leaving again at 1, be occupied steadily until 5:30. Of course it is seldom possible to arrange routes which will work out as accurately as that—but how nearly can he come to it? That is the problem of the route planner.

Following Up Time Studies. Now it often happens that truck transportation depends for its efficiency on other forms of transportation, such as trains, ferries, and so forth, whose schedules cannot be changed. It is obvious that time studies carried out to a very fine point will repay the truck owner here.

A Jersey City coal dealer who had recently installed trucks, came face to face with the fact that he was not making any money. Coal prices had not changed, but he was barely breaking even in a trade that had always been good. Investigation revealed the trouble at once. His trucks instead of taking four loads apiece to Manhattan Island every day, were only averaging three. They were losing time in the line-up at the ferry-slips. They often had to waste an hour to cross the river, and a delay of two hours was not uncommon. They were making three trips a day, while the price charged consumers was based on four trips. It was in making a fourth trip that the dealer's profit lay.

About that time a street traffic engineer was engaged by Jersey City business men to investigate the ferry schedule. His method was the simple one of the census. He counted the number of trucks and other vehicles that crossed the ferries each day

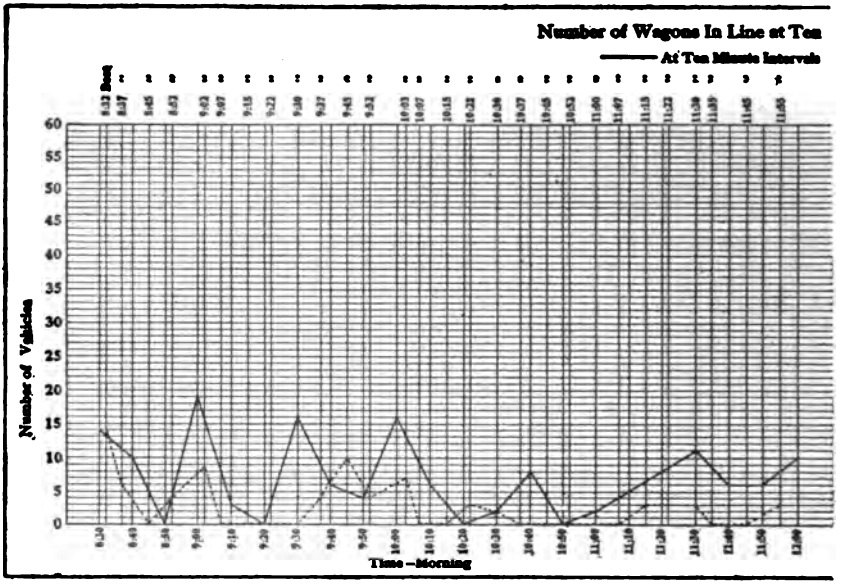


FIGURE 91: Slow ferry service will hold up a fast truck as long as it will a plodding horse. The only difference is that in holding up the fast truck the results are more serious. This chart includes the portion directly opposite.

and was soon able to show that the poor ferry service was costing in time alone over a thousand dollars a day. In the end the situation was improved. (Figure 91.) But during the investigation valuable charts were produced, and the truck owner by revising his routes in order to avoid the hours when congestion at the ferries was at the "peak," reduced his delays and was able to make the necessary fourth trip per day. Much the same problem is met with in street traffic, and the merchant who is laying out his delivery zones will find that it pays to get data on the congestion of certain streets and bridges during rush hours so that he can design his routes to avoid delays. (Figure 91-A.)

How to Plan Your Routing. Congestion of the streets is an important factor in route planning and should be given careful consideration. The city hall is a good place to go for information regarding your territory. In most large cities a traffic census is taken from time to time, giving the number of vehicles which pass certain points during slack and busy hours. In Chicago, for example, the Bureau of Municipal Research has made a number of observations at busy corners.

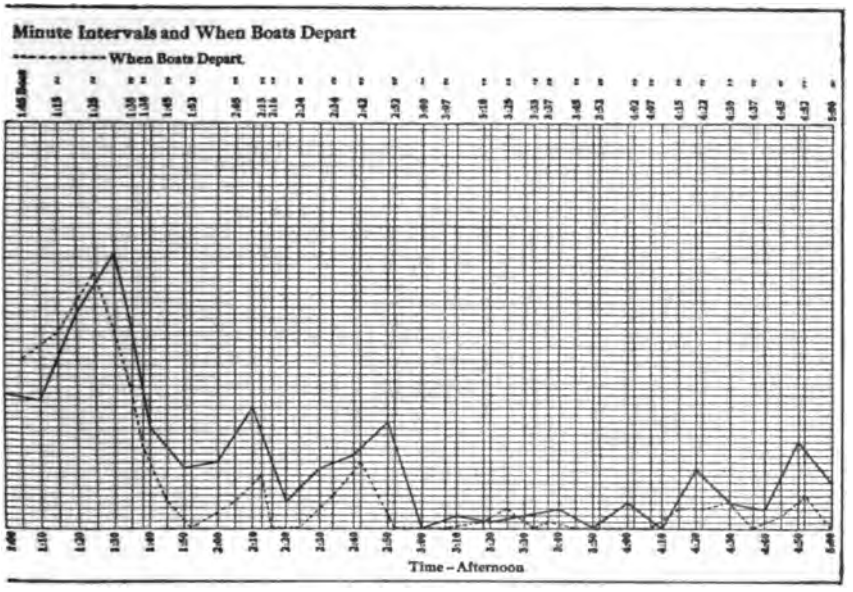


FIGURE 91: The traffic expert who designed this chart made a careful study of Jersey ferry service and succeeded in working out a trip schedule, which not only facilitated deliveries, but saved many dollars formerly eaten up by delays.

Condition of roads also has been a decided bearing on routes, and often it is wiser to travel two or three extra miles in order to avoid a bad stretch of street. Here again the city hall usually has a record of streets closed or torn up. Wise shipping bosses keep all such information in plain sight, where the drivers cannot overlook it. One man keeps at the side of his desk a large scale city map on which he marks with colored tacks and slips of paper the main thoroughfares and street intersections—white for those to be used, red for those to be avoided. A blackboard is also employed to bulletin especially bad road conditions as they are reported by drivers returning from their trips. Some owners issue positive orders that their trucks shall never leave the paved streets, and use their horses and wagons to cover the rough roads, and in some instances this proves such instructions practical.

Taking Advantage of Strategic Points. Some concerns build their delivery zones with reference to railroads and rivers, making spur tracks or docks their strategic points. Such routes are often very irregular in shape, and seemingly illogical in arrangement, but as a matter of fact they are very efficient.

As an illustration of how such a delivery system can be planned and worked, there is in Chicago a certain coal company which handles 10,000 tons of coal per month and yet does not own a single coal yard! The entire business is handled from "team tracks," and the coal unloaded and delivered so promptly that in a year's time the company did not pay a cent of demurrage.

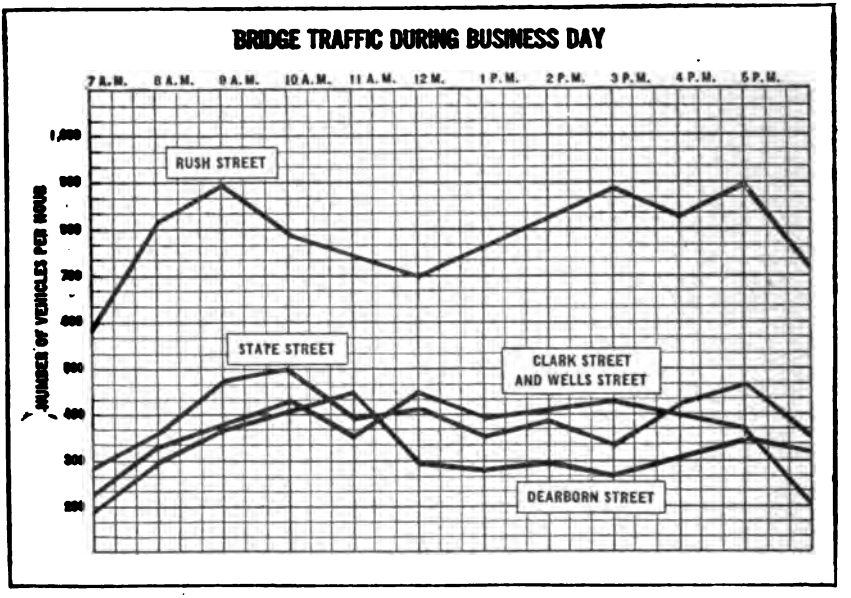


FIGURE 91-A: Often bridge jam delays are simply a question of the time of day. This chart gives a "census" of truck crossings over congested Chicago bridges. Truck owners have found that by avoiding the peaks, costly delays may be cut down.

The great advantage of this plan is that the coal company does not have to haul coal from one side of the city to the other in making deliveries. Instead, the railroad lays it down at the nearest "team track" and the truck carries it a short distance, half a mile or so, to the consumer. At the same time certain other coal companies, who operate from one or two main yards are known to be hauling coal ten or twelve miles in some cases to make delivery. Cases have been reported where the cost of hauling coal across Chicago has amounted to as much as the price asked for the coal itself.

At the other extreme is the depot system of delivery, familiar to many persons because of use by department stores and other stores which have many small packages to deliver.

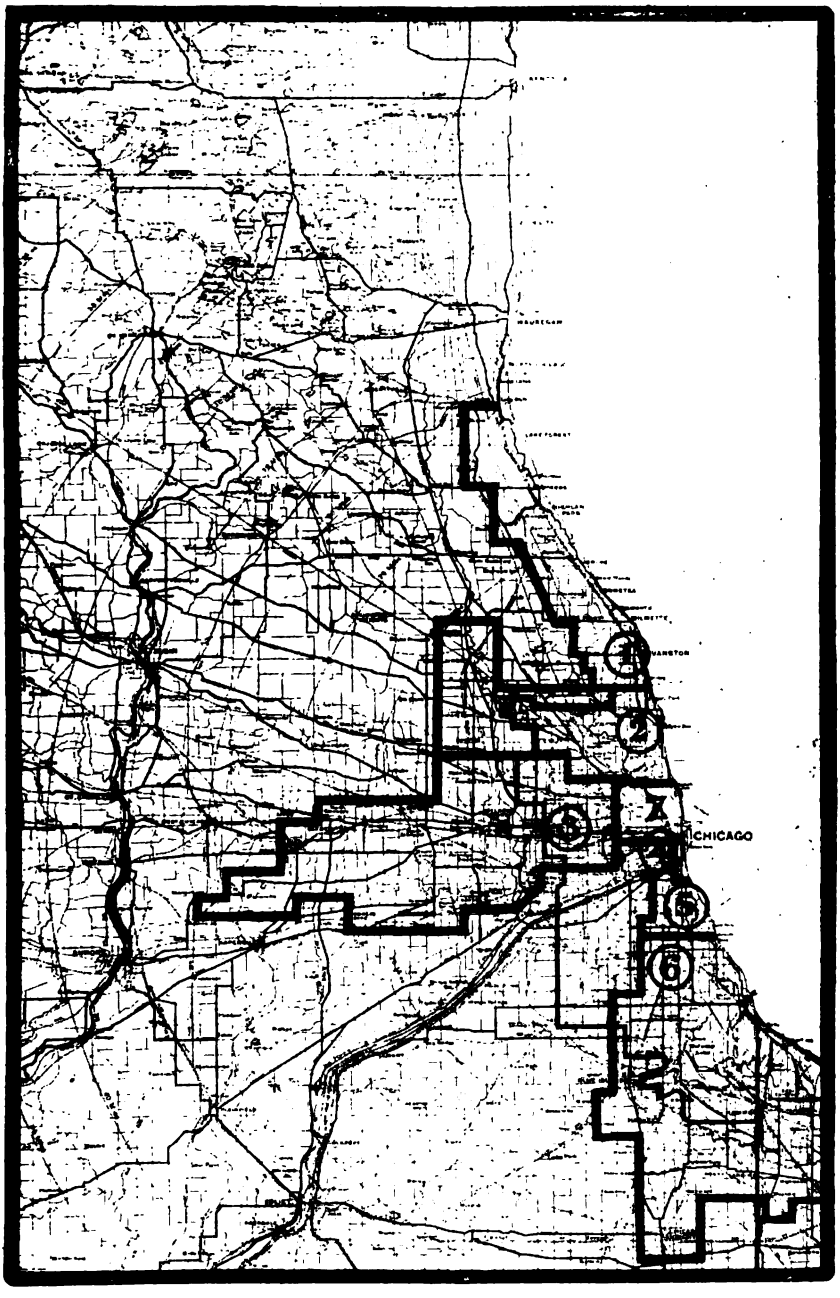


FIGURE 91-B: Above are diagrammed the zones into which 10,000,000 packages a year are delivered by a great Chicago store. Large trucks speed from a central warehouse to distant substations where their loads are divided up among small, speedy cars which make the house-to-house deliveries.

FIGURE 92: Here you have at least three striking economies in the handling of coal. The grab-bucket loads the truck with one "bite"; the sidewise dump unloads it in 30 seconds and the searchlight equips the truck to work at night.

FIGURE 93: Pulling one lever loads this truck; pulling another unloads it. The huge buckets are round on the bottom, and roll over easily. In this case the trailer adds 50% to the normal pay-load of the truck.

FIGURE 94: Dumping rubbish requires a high angle of tilt in the body. Here the truck has moved slowly ahead, spreading the load and facilitating its unloading. Notice the side rail, on which barrels or boxes can be carried.

FIGURE 95: This coal comes direct from the mine to the trucks. Gates in the chute check the rush of the coal and regulate its flow. The column between the truck body and the driver's seat contains a hydraulic hoist which dumps the load.

FIGURE 96: This special body is of simple construction and has been found very effective in solving the delivery problems of manufacturers whose products are handled in cases, especially those of bottling concerns.

FIGURE 97: Tremendous power, in addition to a high percentage of efficiency, as an aid to speeding up loading, is behind this traveling hoist. In large warehouses, shipping docks or freight terminals it has a thousand and one uses.

How Substations Save Delivery Costs. In the chart shown in Figure 98 is given in simple outline the history of transportation of a load of parcels from store to customers. From the store out a distance of eight or ten miles is a long, black line, which indicates continuous travel. At the end of this line, however, the character of the route suddenly changes. There are numerous stops connected by short trips averaging a quarter of a mile in length. The parcels are being delivered to over a hundred customers.

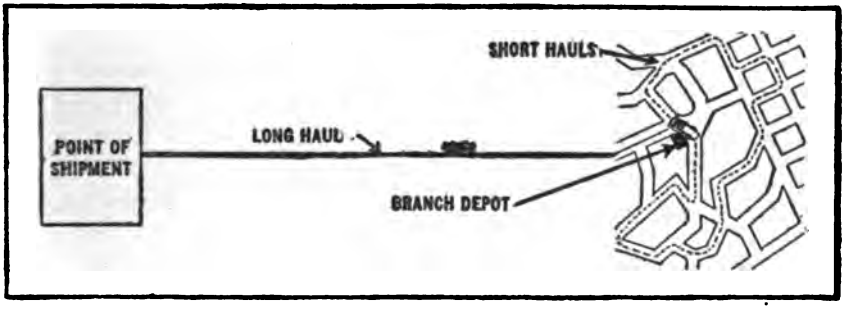


FIGURE 98: Here is shown in skeleton form, a route combining one long and numerous short hauls. It is the problem of every concern whose trucks must make long trips before they can make house-to-house deliveries.

The delivery problem is that of combining the long haul and the short haul in the same route. So far as the long haul is concerned it is probable that the biggest truck will prove the most economical. How is it, however, when a stop is made to deliver a parcel? One has merely to imagine a $5,000 truck and an $800 delivery car standing side by side to realize that it is costing much more to deliver the parcel with the large truck than with the small one, and there are so many parcels to be delivered, so many stops to be made during an afternoon, that the difference in cost is quite pronounced.

How is the problem solved? By the use of stock depots. Large trucks carrying enormous loads of bundles go from the store to the depots without a stop. There they leave their loads and return. In the meantime, light, fast, and comparatively inexpensive delivery cars split up the load and deliver the bundles from house to house. When one of these cars waits five minutes the delay is not of much consequence in dollars and cents.

Handling 10,000,000 Parcels a Year. Let us, for example, consider the problem of a great dry goods store in Chicago.

In this particular concern the wholesale and retail ends of the business, although naturally distinct in every respect, are coupled up together in the delivery of merchandise. It is like a railroad. There is the great volume of heavy slow freight that must be moved, and also the fast mail and express, all over the same tracks.

Retail delivery is divided into two general classes: "parcels" and "furniture." In the case of parcels, gasoline trucks deliver the packages to six subdelivery stations which are located at carefully determined centers throughout the entire city. These substations serve both as garages in which trucks can be stored and as delivery distribution points. From each substation a small radius is swung and the enclosed territory is served with electric delivery cars. From the same center a longer radius is again turned and this outlying territory is served with small gasoline cars.

Over 10,000,000 parcels are handled every year under this plan. Christmas deliveries at times care for over 80,000 packages a day. For furniture and heavy retail delivery, light gasoline trucks are used for the entire territory. Furniture is delivered to points within fifty miles of the store. Nineteen 2-ton and two 1½-ton gasoline trucks are used for this work. (Figure 91-B).

The Routing for Substation Deliveries. The routing of deliveries through the six substations is handled as follows: Station 1 is in a suburb to the north of the store. Two daily deliveries are made to customers within a 13-mile radius and one to customers farther away.

Substation 2 is south of number 1, and therefore nearer the store. Three daily deliveries go to points within a 3-mile radius, two to points within a 7-mile radius and one to points within a 14-mile radius.

Substation 3 is about as far west of the store as number 2 is north. Deliveries are handled about the same as they are at sub-station number 2, except that the longest delivery goes to the edge of a circle with a 25-mile radius.

Substations 4 and 5 handle three deliveries a day to the entire delivery area served by the store. Number 4 is located within easy reach of the store and its two warehouses, in the business section of the city. Number 5 is about as far south of the store as number 2 is north.

Substation 6 is not quite as far south of number 5 as number 1 is north of number 2; still it corresponds to number 1,

since it is the substation farthest out among the suburbs to the south of the store. It handles three deliveries a day within a 7-mile radius and one within a 32-mile radius. Trucks working on the long routes covered by this substation at times travel 125 miles a day.

All furniture deliveries are handled direct from a warehouse. So there are in fact seven delivery substations under this system.

The sorting of parcels preparatory to distribution to the six substations is handled in the customary manner. Spiral chutes carry the wrapped purchases to a subbasement. Next they progress by means of belts and other mechanical conveyors to the sloping side of a big sorting table.

High-speed belts are here at hand for transferring them to six compartments representing the six substations, and sorters segregate them and place them on the proper belts. The route, purchaser's name and the address is recorded for each package by inspectors. In this manner the packages for each of the six substations reach the loading platforms after being brought to the street level on an escalator in boxes 42 by 30 by 24 inches. Each truck running to one of the substations takes 51 boxes. This makes a load averaging over five tons.

The boxes, after the trucks have carried them to the proper substations, are emptied and their contents again sorted, this time into bins. From these bins the parcels are loaded into the lighter electric vehicles which handle the house-to-house deliveries.

The delivery of purchases at wholesale is also divided into two classes—general city delivery, and heavy hauling between freight houses and warehouses. For the first class, small electric trucks have proved most satisfactory for short hauls; for longer hauls two-ton gasoline trucks have been adopted.

CHAPTER X

CARRYING MORE GOODS WITH SPECIAL BODIES

WHEN men hauled goods in wagons they were accustomed to piling on the load without regard to whether the merchandise and the wagon body were adapted to each other or not. Waste space, like waste time, meant little in the days when the horse did the hauling.

But the motor truck, with its increased cost, and the greater speed and capacity, which alone justify its increased cost, multiplies any kind of waste, whether it be the waste of standing idle an hour, or the waste of running an hour with a load so poorly packed that half the available space in the body is not utilized.

Load and speed are the two factors by which truck efficiency is figured. A truck carrying half its capacity load is considered to be "half idle." If this is brought about, as occurs daily in hundreds of instances, by some fundamental condition in the business which cannot easily be changed, then the relative loss of efficiency must be borne. But if it is caused by the lack of a proper body, one designed for the special work in hand, the "idle space" is inexcusable.

The Advantages of Convertible Bodies. A western farmer, who uses a three-ton motor truck for general purposes about his farm, has more than doubled the efficiency of his truck by installing a special body so designed and constructed that it can be converted into several different shapes, each one adapted to the hauling of some special product of his farm. It may prove profitable for business men who have similar hauling problems, to examine rather closely the ways in which this single body is used to take care of various hauling conditions.

Body E, in Figure 102, shows its normal position. The sides are vertical and tight, like a box, which fits the body for the carrying of fine and compact material. This farmer uses it for

cereals, clover, and fine, loose materials, but a contractor might use it for hauling sand, or a coal dealer for carrying loose coal which has not been packed in sacks.

The farmer finds, however, that in hauling such material as baled hay, boxes of fruit, or vegetables, and so on, he requires a little more space, inasmuch as such products are bulky, taking up a great deal of room in proportion to their weight. Moreover, he no longer requires a body that is grain-tight. Accordingly, Body B in Figure 101 takes care of his requirements. By the simple expedient of tilting back the upper half of the two sides, that is, by making "flareboards," the capacity of the body for carrying material that can be heaped up is greatly increased. While the farmer made use of this body in carrying boxes and vegetables, he was able to carry a load of cabbages which was peaked up two feet above the top level of the flareboards. Materials in other lines of business can be well taken care of by this special type of body. Thus bags of cement, lump coal, implements, trunks and baggage, groceries, rubber tires, meat, beer, and certain kinds of hardware can be hauled most economically in a body of this kind.

The Use of Flareboards. The controlling principle is that material which cannot be closely packed, but which can be heaped up readily and will not flow easily is best carried by a body which, while not necessarily deep, has been widened as much as possible by the use of flareboards.

When the farmer tried to carry potatoes and peas piled loose in the body of the truck, he found it necessary to draw up the backboard and make the body practically tight in order to prevent the load from running out. (Body D, Figure 101.) The same thing would have been true if the load had been brick, crushed stone, fruit, or scrap metal. The flareboards provided the additional carrying room necessary, and the high tailgate kept the semifluid load from spilling out.

The farmer often finds it necessary to use a truck to take gangs of laborers to the fields quickly, or to bring men from a distance. But it is by no means the farmer alone who has such a use for his truck—contractors and builders of all kinds must frequently transport men great distances in the morning and bring them back at night. What is required, is, briefly, a body having seats for the men and guard rails to keep them from falling out. This end is accomplished by Body G, in Figure 102. It

will be noticed that the seats do not take up any of the room in the body proper, but are suspended outside, being held up in fact by the same struts which were used to support the flareboards.

The Slat Box. Again the farmer found it necessary to transport hogs, sheep, and poultry to market. A simple slat box solved his problem as shown in Body C, in Figure 101.

But he found that he could not transport horses or cattle in such a body, because the top was not high enough to permit the animals to stand up. He solved this problem by leaving off the roof, which was not necessary in the case of cattle, and used the roof pieces to extend the sides, increasing their height by three feet as shown by Body A. Standards, furnished with the body, were raised and provided the support for the high sides.

One more problem: How was he to haul unbaled hay, straw, or grain, which requires an enormous amount of room?

The answer was found by applying the flareboard principle of construction to the sides. This would not have been possible had the material carried been heavy as well as bulky. Thus an unwieldly piece of furniture would have crashed through these flimsy sides, but hay or straw could be carried without possibility of the body's giving away. In the same way concerns hauling empty tubs or light barrels, pasteboard boxes and small packages, such as towels, burlap bags, old paper or light rubbish can make use of this type to advantage. (Body F, Figure 102.)

The Question of "Empties." The truck which takes out thirty barrels of oil must sooner or later carry thirty empty barrels back. But thirty empty barrels do not weigh nearly as much as thirty full barrels, in fact, the truck which hauled the thirty full barrels could haul 150 or even 200 empty barrels, if there were only a place to carry them. What is true of barrels is true of boxes, cartons, kegs, or other containers.

One clever merchant solved this problem in a unique manner. Recognizing the fact that more space was what he needed he included it in the body of his truck. He extended the body in a manner no one had ever thought practicable before. He built, in front, a tremendous overhang which extended over the driver's seat and beyond the radiator of the engine. (Figure 99.) This "hanging gallery" of course did not possess much strength, as it was impossible to support it satisfactorily by underpinning. It looked crude and mechanically unsound. But, the material to be carried, empty barrels, weighed almost nothing. They took

FIGURE 99: Here is a striking example of a special body built to meet a special need. The ordinary body of a truck would allow for scarcely a hundred empty barrels, but here you have an example of a special body carrying 289 empties.

FIGURE 100: The truck owner who has a great many small parcels for delivery may find in this wire-net body the equipment he is looking for. A package lost often means a dissatisfied customer. This may be prevented by a body of this type.

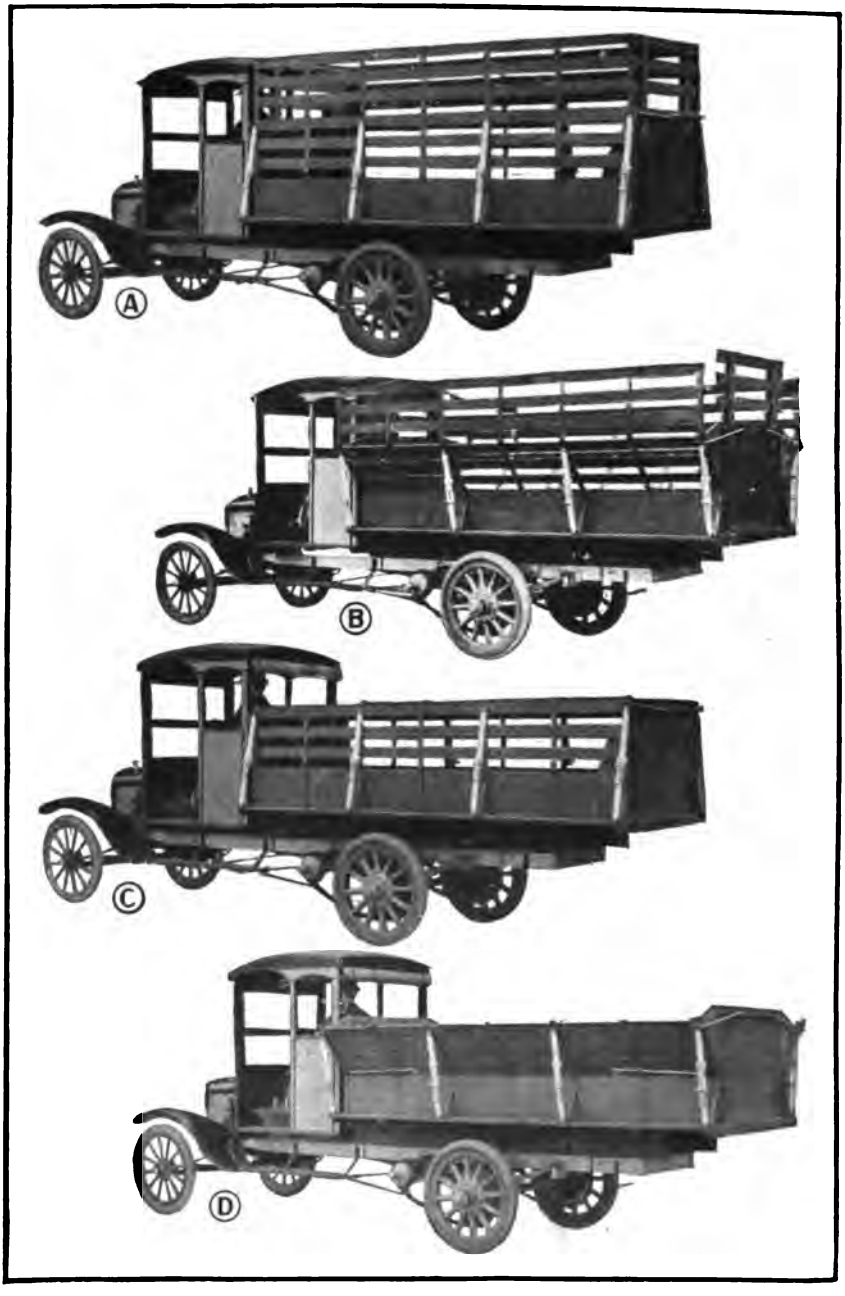


FIGURE 101: The seven bodies shown on this page and the page opposite, have every appearance of being separate bodies, but, as a matter of fact, they are not. It is one special body so constructed that it may be converted into these different shapes and thus serve for as many different uses.

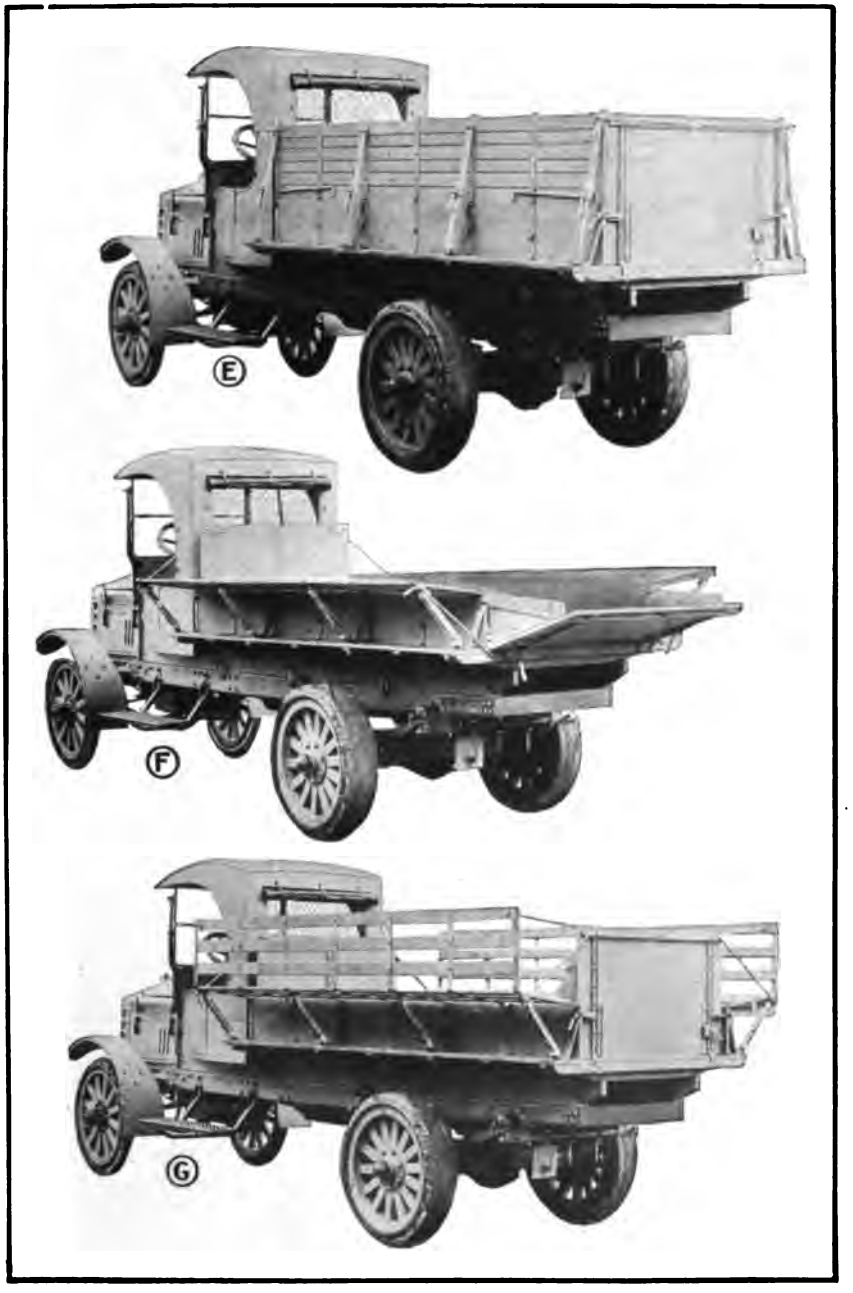


FIGURE 102: It will no doubt prove profitable to every truck owner who has hauling problems to solve which require several types of special bodies, to examine closely the many uses to which the one special body shown on these two pages may be profitably used. It is fully explained in this chapter.

FIGURE 103: Here is a special body for handling cotton bales. Not a body-builder's job, but made by the firm's own carpenters out of a few planks and joists. It consists of side rails and high sloping side against which the bales rest

FIGURE 104: Another view of the cotton truck shown above. Notice how the bales are arranged. This facilitates unloading as well as loading. The short space directly over the rear wheels serves as a convenient perch for the helpers.

up room, but they did not weigh fifteen pounds apiece. To the eye the truck, carrying its load of 289 barrels, looked overburdened. A little figuring, however, showed that the vehicle was "staggering" under less than a capacity load.

Truck owners make more profits by carrying a uniformly greater load. That is, not an overload, but rather an avoidance of underload. Translated into terms of body efficiency, it means that motor trucks are made more efficient by equipping them with bodies which are scientifically designed and adapted for the character of the cargo to be hauled. A dump body is of little use in the dairy business; a closed body is not suitable for the contractor. Different materials indicate in a general way the kind of body best fitted to carry them; man's ingenuity goes deeper into the problem and produces special contrivances which expedite to the last degree the process of loading, unloading, and carrying merchandise.

A company handling bottled spring-water devised a special body which proved very effective for carrying their bottles. The body is simplicity itself, being a simple platform with a flareboard on each side and so constructed that two guide beams run the length of the body. They are separated from each other by the width of two five-gallon bottles, which provides a space for compactly packing a double row of bottles. As it would be difficult or dangerous to pile bottles on top of each other, additional packing room is obtained by utilizing the flareboards. A row of bottles is packed along each flareboard, and here the guide beams on the floor of the body are once more of service, because they are stout and high enough to keep the heavy bottles in place.

This simple expedient used by a dealer in large single bottles, is suitable for dealers in small bottles handled by the case, such as soda water, pop, or beer. It is merely necessary to make a few measurements of the cases regularly handled.

Special Bodies for Baled Materials. How the engineer of a Galveston cotton house solved the problem of handling cotton bales by motor truck is illustrated in Figure 104. It was the practice in that city to haul cotton on large flat drays, sloping to the rear. When motor trucks were first introduced the ordinary flat body was used on them. The bales were lifted and piled on the beds of the truck, and a great deal of shoving and hoisting was necessary before the loading was accomplished.

It occurred to the engineer in question, that if a way could be devised for eliminating the lifting of the heavy bales, a great improvement would be accomplished. Accordingly he built a special body having low side rails. (Figure 103.) The body itself was in the shape of a triangle with the top cut off. Instead of lifting outright the heavy bales, which weigh over 500 pounds, it was merely necessary to "up-end" them against the sloping side of the body, the lower end of the bale resting on the side rail. It was not even necessary to rope the bales in place as they lay back by the force of gravity against the sides of the triangle. This same principle could be used in handling baled hay, or other material packed in large and heavy bundles. In passing, it may be mentioned that the truck in question is an electric. Gasoline trucks were not allowed on the wharves where the cotton is stored.

A special body for handling lumber is used by a Toronto concern. It is simplicity itself, for it is merely a stake platform body in the bed of which are four rollers lying horizontally across the floor of the truck. (Figure 106.) The hindmost roller is roughened and is turned by a crank, rolling the load of lumber either on or off the truck. The other three rollers serve as idlers. With this body it was found that the average time required to load was from five to eight minutes, and that the load could be taken off in from three to five minutes.

A Clothing Store on Wheels. Equipped with a body having side and rear doors and various different-sized interior drawers, the truck shown in Figure 107 is owned by a Bangor, Me., clothier, who has increased his business in the surrounding rural community by taking his goods to his customers instead of requiring them to come to him. He has been able to do this primarily by the use of a motor truck, which has made it possible for him to cover a large amount of territory in much less time than it could be reached with the available transportation facilities and to secure business in areas which he could not enter formerly because of a lack of transportation facilities. Moreover, by fitting a novel type of body on the truck, he is enabled to carry his goods, such as clothing, shoes, and so on, without damage en route, and in such a manner that each particular class of goods may be withdrawn easily and conveniently without the necessity of disturbing the remainder.

The body is of the usual panel type, except that it has a door on each side in addition to the conventional opening at the rear.

FIGURE 105: A simple idea is back of this special body: why hoist heavy bales of cotton on top of the truck when it is much easier to carry them on side rails which are only a few inches above the street? The plan saves time and labor.

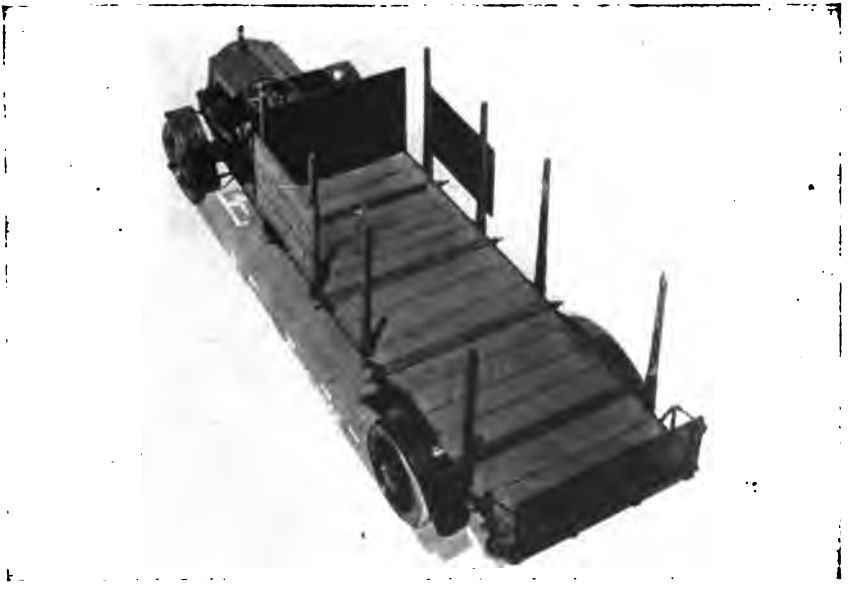


FIGURE 106: Notice the four rollers set in the bed of this lumber truck. Lumber is easily rolled on or off. Generally, one roller is roughened in order to "take hold" and turned by a crank, while the others are smooth and serve as "idlers."

FIGURE 107: This looks like a comparatively simple, not to say ordinary, truck for a clothier. Once you lift up the side and rear panels, however, you discern that it is much more than what you thought; in fact, it is really his "business location."

FIGURE 108: This is the same truck as the one shown in Figure 107. By arranging a series of convenient and compact sliding draw rs in the body of the truck, this enterprising merchant brings his store to his customers.

FIGURE 109: This truck carries milk in two forms, liquid and evaporated. This tank carries the liquid. To haul the dry milk this body is hoisted off by crane hooks attached to eyebolts on both sides of the body, leaving a plain platform body.

FIGURE 110: The tank body (see Figure 109) has been hoisted off and stakes have been set down into sockets already in position. The truck is now able to carry boxes, bags, packages, or, as in this case, barrels of dry milk.

FIGURE 111: This truck has returned to the warehouse with a load of furniture in a demountable body. The body is being rolled off on a hand truck, so that the motor truck can take on another empty body and speed away for another load.

FIGURE 112: This truck body saves money for the city of New York in several ways. Note the overhang, which enables the body to "lean over" the edge of the dock and deliver the load of refuse right into the waiting barge.

Both of these doors differ from the regular construction in that they are hinged at the top and bottom instead of the sides, the lower halves swinging down as shown in Figure 108 to form platforms on which the driver may stand to gain access to the interior drawers. There are twenty-two of these, nine of which are reached from the side door and the remaining thirteen from the rear. Each drawer is of a different size to best accommodate the goods it is to carry and each is equipped with rollers.

How New York City solved the problem of hauling garbage and ashes by means of a specially designed body should be of interest to every municipality which is facing that pressing problem. These features were responsible for its difficulty:

1. How to secure great capacity
2. How to make the truck easy to load
3. How to make it easy to dump

Manufacturers solved the problem as shown in Figure 112.

1. The body of the truck was designed with a length of 13 feet 3 inches and a width of 7 feet 6 inches, and extra high sides were built, giving a capacity of 252 cubic feet, or the equivalent of from 110 to 122 canfuls of ashes, or five one-horse cart loads. The rear was extended to provide additional capacity.

2. With the high sides the truck would have been difficult to load from the street. The sides were made of removable sections, but more important still, a side rail on either side was provided on which barrels could be rested preparatory to dumping them into the truck.

3. The extended rear facilitates dumping, especially where it is necessary to back the truck to the edge of a pier and dump the contents directly into waiting barges. The overhanging rear construction made this easily possible.

A special body for delivering coal is shown in Figure 170. The body can be elevated by struts at the four corners. A gravity pitch is built in, which takes the place of the missing dump principle. This construction is further refined by the basket-shaped receptacle at the bottom.

How an ice dealer has equipped his truck with a special body is told in a letter written by a Middletown, Ohio, ice company.

"We had a special bed made for this truck. Underneath this bed we had a riveted non-corroding pan which slips in and out. At the rear end of this pan there is a cock to take care of the drainage into the pan. This feature we had built in, in order to keep the moisture off the machinery."

Combination Tank and Stake Body. The California Central Creameries have in service a 5-ton combination tank and stake body truck, for which they have provided two bodies. Figure 109 shows the truck carrying upon its platform a sanitary copper vat of over one thousand gallons capacity. This is used in transporting liquid milk from the receiving stations of the California Central Creameries to their main dry milk factory at Ferndale, California.

Now observe that Figure 110 shows this same truck with high stake body, as it leaves the factory loaded with five tons of "Golden State" dry milk.

So much for the method by which this unit has been adapted for bringing the raw material—a liquid, and later carrying the finished product, evidently a powder—to the point of shipment.

Arrows shown in Figure 109 point to stout eyebolts provided on top of the heavy skids supporting the copper tank, balanced by two others on the opposite ends of the skids. How simple, then, to slip in the crane hooks, hoist off the tank, place the stakes in their sockets, and *presto!*—an entirely different body.

An Interchangeable Body. One of the most interesting body installations is that used by the Manhattan Storage and Warehouse Company, New York. It is shown in Figure 111. The spare body is an exact duplicate of the expensive original one. Two four-wheeled, wide-tired trailers are provided. An empty trailer is put in place in back of the vehicle from which the body is to be removed. Then, by means of a crank, the driver or helper removes the body, which automatically slides upon the trailer. With the body upon it, the trailer can be pulled to any desired position by hand. A chain runs along the chassis of the truck, and this carries the body to and from the chassis. As the chain does not run the full length, a V-shaped iron is placed on the front of the body to be dropped into position on a hook in the chain, and is thus carried to the end of the chassis frame and pushed off upon the trailer.

CHAPTER XI

PRINCIPLES GOVERNING THE USE OF TRAILERS

AN eastern street commissioner recently set himself the task of cutting down the cost of collecting and hauling garbage from the city to the disposal plants. Up to that time, the city had used ordinary wagons drawn by two horses. The commissioner had not only decided to try out the motor truck in this work, but he resolved to test the principle of the trailer as well. He had been told that the average well-built truck is able to haul behind it three or four times as much as it can carry. Accordingly, he conducted a test as follows:

The regular horse-drawn wagons were used to collect the garbage from the districts, bringing it to a designated place, where the horses were unhitched and the loaded wagons attached to a truck. The truck used was a 5-ton model of a well-known make, and was not in any way specially designed for tractor service. (Figure 113.)

After four loaded wagons were thus hitched on to the truck, a load of four and a half tons of scrap iron was placed in the truck body in order to give traction to the driving wheels. The train was then set in motion.

One Truck Pulls a 27-Ton Load. The road traveled passed under viaducts, around sharp turns and up steep grades. The truck, however, was able to swing its train of four loaded wagons round the curves without difficulty. At one place on the road, near the city line, there was an "S" turn, followed immediately by a sharp upgrade. After descending the incline on one side and making the double turn, the truck was stopped at the foot of the grade, and then made to pick up its load again and proceed on up the hill. Witnesses, including the mayor and the city engineer, as well as officials from other cities, were on hand and watched the experiment closely. Although rain and

sleet had made the road conditions very unfavorable, the 5-ton truck started and, with its four loaded trailers (together with the load of iron which it carried), pulled up the hill without a stop. The total load, excluding the weight of the trailers, was 27 tons!

As a result of this test covering a round trip distance of 22½ miles, trailers were purchased by the city, and half the number of horses previously used were disposed of. The remaining horses are used for house-to-house collection, but the loaded wagons, hitched together in groups of four, are now hauled by motor trucks to the disposal plant. Here is a case, witnessed and attested, where a standard motor truck which was rated to carry 5 tons, actually hauled a load weighing over five times that amount a distance of 22½ miles. Twenty-seven tons hauled by one truck in one trip—by the use of trailers!

But this record is not exceptional. In Detroit a dealer in crushed stone hauls thirty tons regularly with one truck. In Los Angeles recently a 33-ton boiler was hauled by a single tractor (Figure 114); in an Indiana town a 2-ton truck pulled a train of six trailers carrying three hundred sheep (Figure 115), and in Chicago recently an enormous dynamo weighing forty-three tons was hauled by one motor truck.

What is the meaning of these extraordinary performances? How does the trailer enable the merchant to haul loads five, seven or even ten times heavier than his truck is guaranteed to carry?

First of all the trailer utilizes the surplus power of the engine which otherwise would be wasted. One trailer manufacturer states the case in these terms:

"For every ton your truck carries on its body, it can pull from three to four tons more on a properly constructed trailer. A 1½-ton truck can carry its ton and a half and pull six in addition—total seven and a half tons.

"A 3-ton truck can carry three tons and pull twelve more—total fifteen tons.

"This is because, in addition to carrying capacity, every truck has another and far more important power—drawbar pull."

How the Idea of the Trailer Originated. Let us state the matter in another way. As we showed in Chapter I, primitive man carried his first loads on his back. It was not long before he discovered that by putting the load on a stick and dragging it behind him, he could haul a great deal more with considerably less exertion. He demonstrated, in other words, the principle that it is easier to haul a load than to carry it. He utilized what we today term the "drawbar pull."

FIGURE 113: This truck is rated to carry 5 tons. But it actually hauled 27 tons a distance of over twenty miles, and the feat was witnessed by the mayor and other officials of an eastern city. Can any truck do this under any conditions?

FIGURE 114: Thirty-three tons is an enormous load to carry, but hauling it is another question. Over smooth and fairly level streets one motor truck moves this load without difficulty. In Figure 116 you have a similar instance.

FIGURE 115: Three hundred sheep—only one motor truck! The truck can carry only its rated load, but under favorable conditions it can haul many times that amount. Trailers provide the space and utilize the additional hauling power.

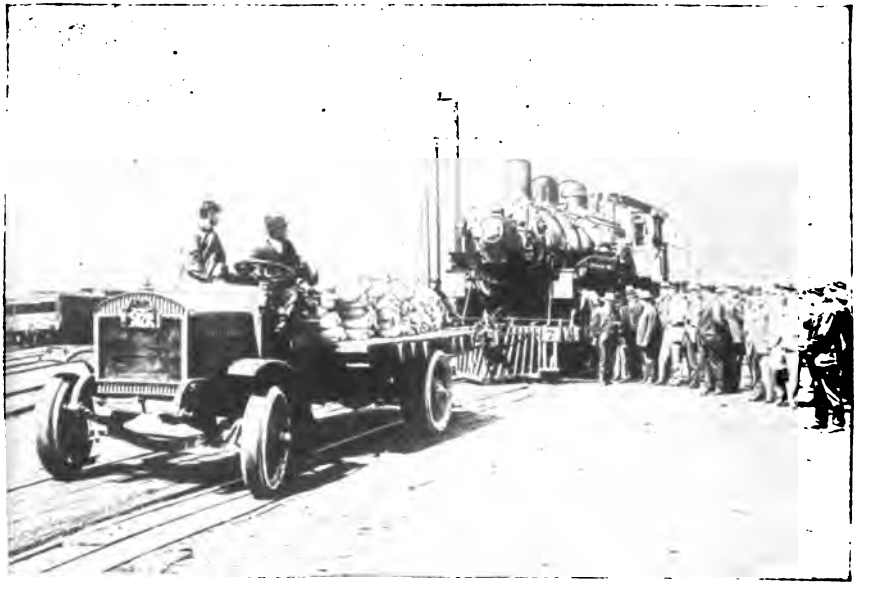


FIGURE 116: How much can a truck which is already loaded to capacity haul behind it? A pound, or, as in this picture, 150 tons! It all depends on the conditions present. That is one of the most important lessons to learn about trailers.

FIGURE 117: Here is a striking demonstration of what may be accomplished by the use of special bodies. This one is mounted on a trailer and hauls twelve automobile bodies at one time. Without a special body this would be impossible.

FIGURE 118: One of the great advantages of two-wheeled trailers is the comparative ease with which they are maneuvered. In this instance the truck is turned at right angle to the load in order not to hold up traffic.

FIGURE 119: The two figures on this page illustrate practically the same tip-bucket principle of unloading. Both of them are operated by levers which require only a quick shove to dump the load. This is one mounted on an industrial truck.

FIGURE 120: Two labor-saving principles are very apparent in this illustration: (1) unloading is accomplished in a few seconds; (2) no backing up is necessary, for it dumps on either side, both of which mean time and money saved.

The locomotive is another case in point. It hauls sometimes 25, 50, or even 100 "trailers." Suppose it were decided to build a locomotive which could carry this tremendous load on its back if there were space for it. The difficulty would be enormous, if not insurmountable. By "trailing" the load, however, the locomotive can be made to haul 200 or 300 times its own weight. The warehouse worker, who would stagger under a load of 200 pounds, puts 2,000 pounds on wheels and hauls it away without difficulty. Insignificant tugs move ocean liners of 10,000 or 20,000 tons' burden.

It was from observing such examples as these that men began to think of the trailer in connection with motor trucks. In other forms of transportation it was generally the practice to place the motive power in front, and to put the "pay load" on some vehicle or train of vehicles behind. But with the motor truck, men had been content to pile the load "on top." When the frame and the springs and the axles and other parts had been called upon to support as much weight as they could safely bear, then the motor truck operator had said in effect: "This truck is now loaded to capacity; it cannot haul another pound."

The Difference Between Hauling and Carrying. As a matter of fact, the truck could *haul* another pound and in many an instance several thousand pounds more, where it could not *carry* any additional load on its back. So we find that it is possible for a truck to be carrying a capacity load, while at the same time its power plant—its ability to *haul* loads—is half or three-quarters idle. As one trailer manufacturer has compactly expressed it: "When your truck is full, it is nearly empty." To this, we add the word of caution: "Sometimes!"

If the average 3-ton truck can carry its own capacity load and haul 12 tons behind it, here is a discovery which is of the utmost importance to the business man who has goods to haul by motor truck. If he is not availing himself of this latent power of his motor truck, he is neglecting a factor which, as can be seen at a glance—might reduce his transportation requirements by 200% or 300%. He is anxious to take advantage of this power which his truck possesses, for he sees that it may have a more important bearing on his transportation problem than all other considerations put together. If Cook & Company are hauling 8½ tons with a 1½-ton truck with trailers, while Hawkins is hauling only 1½ tons, then Cook & Company are delivering

five times as much merchandise as Hawkins with only a little additional expense. The matter is one of critical importance. Let us see if we can get to the bottom of it.

Carrying Capacity and Drawbar Pull. It is often said that a truck has two kinds of capacity: one for supporting a load, and one for transporting it. The former may be called carrying capacity, and the latter drawbar pull. Let us suppose that a 3-ton truck is being loaded. As the load is piled on, the frame receives a certain strain, as do the axles and wheels, and the springs flatten out, until when the entire load of three tons has been placed on the truck, the top leaves of the springs are nearly level. Obviously, the truck has been loaded to its capacity, and any further weight upon it will subject it to a strain which it is not designed to bear. This capacity, then, is a fixed quantity—it is three tons, whether the truck be going uphill or down; and anybody who said the truck could carry 6, 9, or 12 tons, would be at once discredited.

Let us turn now to the other kind of capacity—that for moving or transporting the load. A loaded 3-ton truck is climbing a 20% grade. It is a severe test, for, leaving out of consideration the resistance set up by the surface of the road, the 20% incline means that the truck must exert a constant pull of more than 20% of its weight in order to surmount it. The truck, however, is equal to the task, and carries its load steadily to the top. It has demonstrated very nearly its maximum capacity for drawbar pull. Now suppose we see that same loaded truck spinning along a stretch of level street. It is obvious that the truck is not exerting anywhere near its maximum pulling power. In other words, the truck, although *loaded* to capacity, is not *pulling* to capacity, because, as we have already seen, it has demonstrated its ability to pull the *same* load over conditions which are literally ten times more difficult.

How Much Can a Truck Haul? Why not—and here is where the trailer comes in—why not attach additional loads to the truck and make use of this surplus pulling power which is evidently not being utilized? If a 3-ton truck can haul 3 tons up a 20% grade, it can haul 25 or perhaps 30 tons on a level street.

This brings us back again to the question: How much can a truck haul? Earlier in this chapter we quoted the following statement: "A 3-ton truck can carry 3 tons and pull 12 more." Obviously this statement is meant to express an average, for it

would be impossible to give even in a page a table showing the varying amounts of load a given truck can haul under the many different conditions of roads and grades met with in truck haulage. For instance, the 3-ton truck loaded to capacity ascending the 20% grade could hardly haul a single empty trailer behind it, so nearly has its capacity for drawbar pull been reached. It would be incorrect and misleading, therefore, to say that such a truck (under such conditions) could carry its own load and pull 12 tons more behind it. The 3-ton truck spinning along the level street, on the other hand, could haul not only 12 tons, but perhaps 24 or even 30.

This brings us to the cardinal fact which the truck operator will do well to bear in mind when considering the question of using trailers: The amount of load which a motor truck can haul behind it in trailers depends upon the conditions of the road and grade met with, and may vary from zero to an amount many times greater than the rated capacity of the truck. It is the task of the truck owner, therefore, to determine whether haulage conditions make it possible for him to use trailers effectively or not. What are these haulage conditions and how do they affect the use of trailers with motor trucks?

How Roads Affect Trailers. Have you ever tried to walk on soft beach sand? Your foot sinks in, you can get almost no purchase, and you make progress only by considerable exertion. On the other hand, if you are walking on a brick sidewalk, your feet encounter almost no resistance, and you swing along with little effort. The motor truck encounters about a dozen different conditions of road surface, and each condition offers a different resistance to its progress.

Again, as you climb a steep hill, you are conscious at once that a greatly increased effort is demanded of you, and you arrive at the top, perhaps out of breath. The motor truck similarly puts forth more power as it climbs a steep grade, for, in mounting an elevation of 100 feet for instance, it has been obliged to lift its own weight to that height, although it may have had 800 or 1,000 feet in which to do it.

Road surface and grade, therefore, are the two chief conditions which affect the operation of motor trucks with trailers or without them. Wind resistance, of course, is a factor, as well as the resistance set up in the mechanism of the trucks; but for the purposes of this discussion, we can ignore them.

What is the exact effect of road surface on the operation of the motor truck? Many experiments have been made to determine the resistance offered by various kinds of pavement. The following table gives the generally accepted results of these investigations:

Table of Road Resistance of Rubber-Tired Trucks and Trailers

	Road Resistance in lbs. per ton		*Road Resistance in lbs. per ton*
Asphalt	20	Soft Macadam	75
Wood Block	24	Ordinary Country Clay Roads	100
Smooth Brick	25-35	Ordinary Country Sand Road	150
Poor Brick	35-60	Sand 3" Deep	275-300
Hard, Dry Clay Road or Hard Gravel Road	50		

Suppose, for instance, that a trailer, weighing with its load 6 tons, is being hauled over a level road covered with soft macadam. This surface sets up a resistance of 75 pounds for every ton of weight of the vehicle upon it; hence it would require a pull of 450 pounds to move the trailer over such a road surface.

Mathematics of the Drawbar Pull. The effect of grade or incline is determined mathematically and requires no investigation. A 1% grade requires a 1% pull, to put the matter simply. Suppose a truck with a gross weight of 10 tons is to be driven up a grade of 6%. The force required is 6% of 10 tons, or six-tenths of a ton, or 1,200 pounds. This is often expressed in "pounds per ton," and as a ton is 2,000 pounds, for each per cent of grade to be surmounted, a drawbar pull of 1% of 2,000 pounds is required, or a drawbar pull of 20 pounds for each ton.

When road resistance and the resistance due to grade have been computed, they must be added together in order to give the total resistance offered by the given haulage condition. Let us take a specific example. A 3½-ton truck, weighing 7½ tons loaded, must climb a 4% grade over an ordinary country clay road. The resistance is computed as follows:

(1) Road Resistance, 100 lbs. per ton for 7½ tons ..... =750 lbs.
(2) 4% Grade Resistance, @ 150 lbs. for each 1% ..... =600 lbs.
1,350 lbs.

In other words, it requires nearly 1,400 pounds of drawbar pull to carry the truck up this incline over a country clay road.

Compare this condition with that of a level asphalt street, where the total resistance would have amounted to 150 pounds.

What Do "Stunts" Really Tell? When the truck owner realizes that different haulage conditions offer enormous variations with respect to the difficulty of overcoming them, he will be better able to analyze his own problem and to appraise outside evidence at its true value. Consider, for example, some of the special "stunts" which have given the impression of the tremendous pulling power of the motor truck. In one instance a 43-ton boiler was hauled six city blocks by a motor truck, while all the world wondered. One load of 43 tons! But let us analyze it. Granted that the street was level and, being in a large city, fairly well paved, we can assume that the road resistance was about 25 pounds per ton. This multiplied by 43 gives 1,075 pounds drawbar pull required to pull this enormous boiler. The feat does not compare with that of a 5-ton truck with capacity load traversing an ordinary country sand road.

What Railroad Analogy Reveals. The railroad analogy has often been cited to support the principle of the trailer, and while there is undoubtedly a relation between the two, there is also a difference which the truck owner should fix in his mind. Many persons are accustomed to wonder at the performance of the locomotive which often hauls thousands of tons of freight behind it, and to conclude that it must be an engine of enormous strength. A moment's consideration of the conditions of rail haulage, however, will give the reader a new conception of the case. As in the example of truck haulage, let us consider once more the factors of road resistance and grade. Steel rails offer a resistance to steel wheels of about 9 pounds per ton. That is, given a freight car, which, when loaded, has a gross weight of 50 tons, a sustained push or pull of 450 pounds would be sufficient to keep it in motion! Take the factor of grade. We know that a resistance of 20 pounds per ton carried is added by each per cent of grade encountered by a vehicle. But the railroads are so planned that the maximum grade seldom exceeds 1%. The combined resistance which a freight train must overcome, leaving out wind pressure, almost never exceeds 29 pounds per ton as a maximum, and averages about 15 pounds per ton!

Comparison of Rail and Truck Conditions. Compare this with the conditions of motor truck haulage. As seen in the table on the opposite page, hard asphalt offers a resistance of 20 pounds

per ton, and when the motor truck is running over such a surface, the grade being level, the conditions are not much different from those found in rail transportation. A truck, however, must be designed to climb a 25% grade over an ordinary road surface. Suppose that this road surface is poor gravel offering a resistance of 150 pounds per ton. The grade being 25% offers a resistance of 500 pounds per ton, which, added to the road resistance, gives a total of 650 pounds! Compare this figure with the 15 pounds which is the average combined rail and grade resistance which must be overcome by the locomotive. The task of the motor truck in this case is 43 times as hard!

Truck Hauls Thirty Times Its Load Capacity! No more striking illustration of this whole matter could be desired than that furnished by a demonstration recently conducted in Seattle. A standard 5-ton motor truck of a well-known make was attached by heavy chains to a freight locomotive. At a signal the truck was put in motion. There was an instant's halt before the truck could start the dead weight of the locomotive. Then both began to move slowly ahead. The truck towed the engine two city blocks to complete the demonstration. The locomotive weighed more than 150 tons! (Figure 116.)

But, great as this weight was, it did not test the entire pulling power of the truck. Assuming that the grade was level, we multiply 150 tons by 9 pounds (the resistance of the rail), which gives us a total pull of 1,350 pounds required to keep the locomotive in motion. But this truck could have exerted a pull three times as great, and could have hauled not only the locomotive but seven or eight loaded freight cars as well! At the same time such a truck plowing through loose sand, or up a 10% grade through deep mud, would not be able to haul a single trailer in addition to its own 5-ton load!

This discussion will give the reader some idea of the enormous range of haulage conditions which the truck may encounter in a day's run. It is now possible to chart these conditions. (Figure 123.) Let us suppose that as the truck starts out in the morning, it has to climb a hill having a 25% grade over an ordinary country road. This grade is very exceptional indeed, and will serve to test the maximum power of the motor truck. During the day's run the truck encounters all sorts of road conditions from asphalt to deep mud, and all sorts of grades from 1% to 25%. As it returns at night it encounters the same grade and

FIGURE 121: This illustration shows an effective combination of three very serviceable loading devices—the chain-falls, the overhead crane and the demountable body. All have been installed to conserve the time of the motor truck.

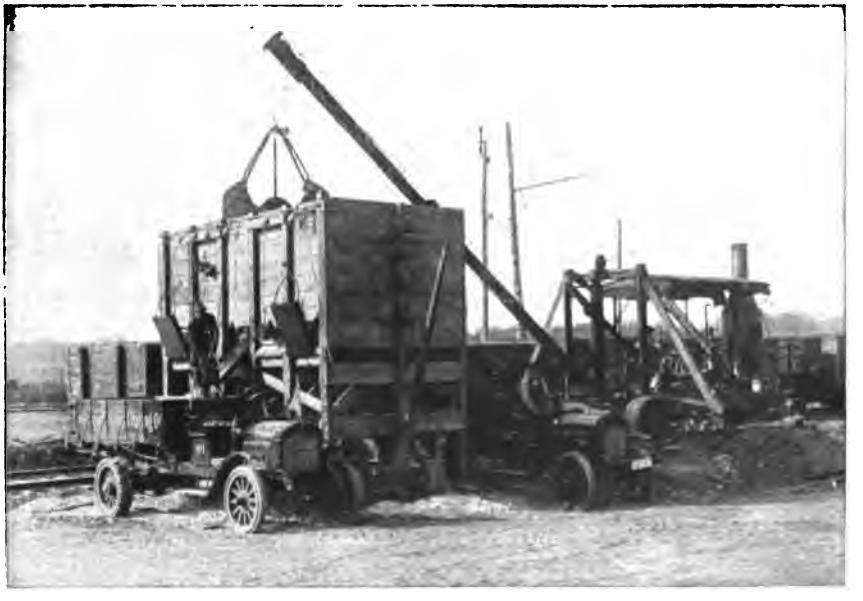


FIGURE 122: The contractor who uses this loading equipment evidently believes in going the limit to keep the wheels of his trucks turning. The overhead pen and the grab bucket are portable and travel from job to job.

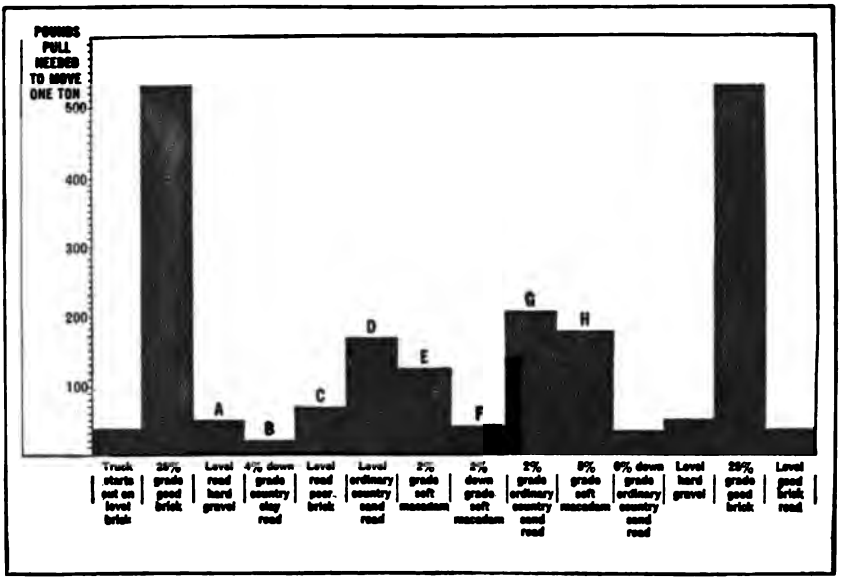


FIGURE 123: If the truck can climb a 25% grade, how much excess power is "going to waste" when it is running on level roads or ordinary grades? The white space in this chart is an unutilized field. It is, in fact, the field of the trailer.

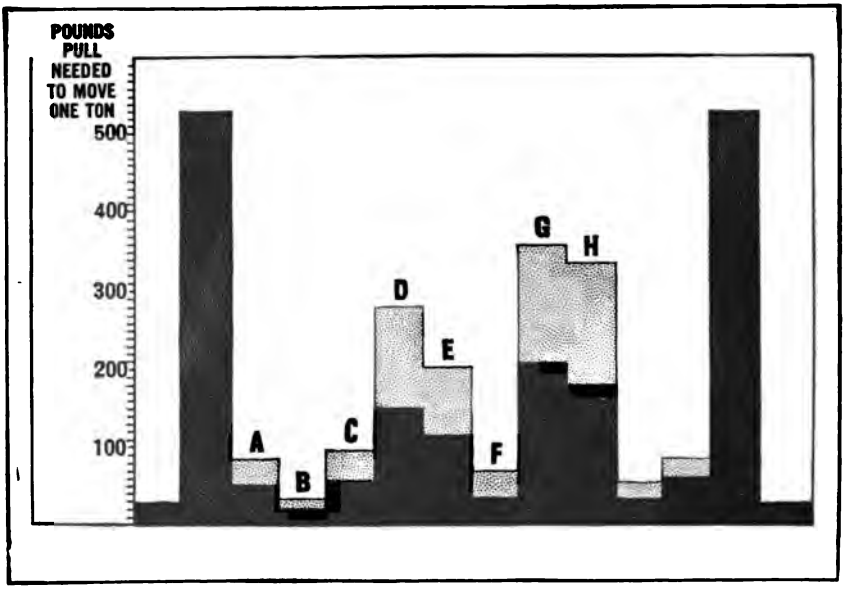


FIGURE 124: Why not attach a trailer? The chart shows that the truck can haul a trailer most of the time with less effort than it exerts under some conditions alone. A careful study of these charts will show exactly why this is possible

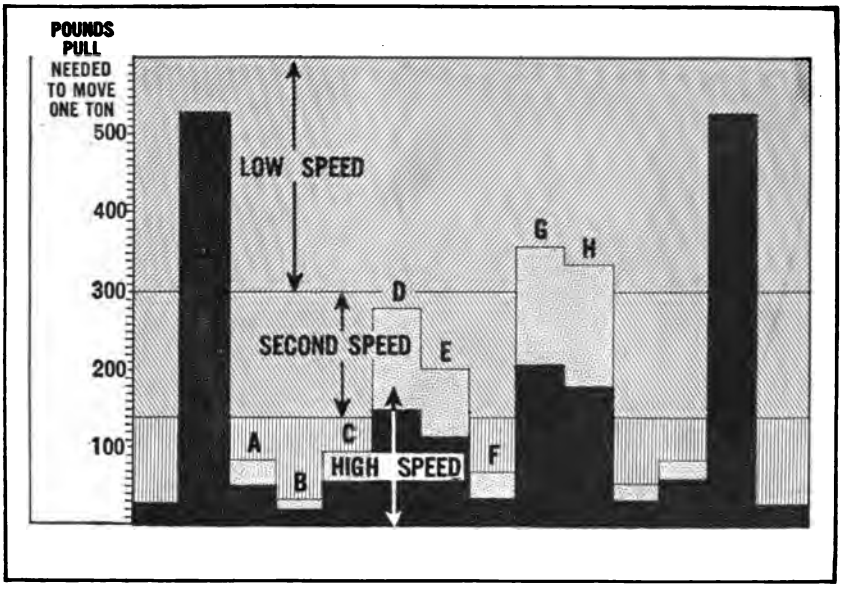


FIGURE 125: Hauling a trailer is one thing—hauling it profitably is another. The speeds of a gasoline truck are almost as sharply defined as the zones in this chart. If speed is reduced the truck may lose in time what is gained by added load.

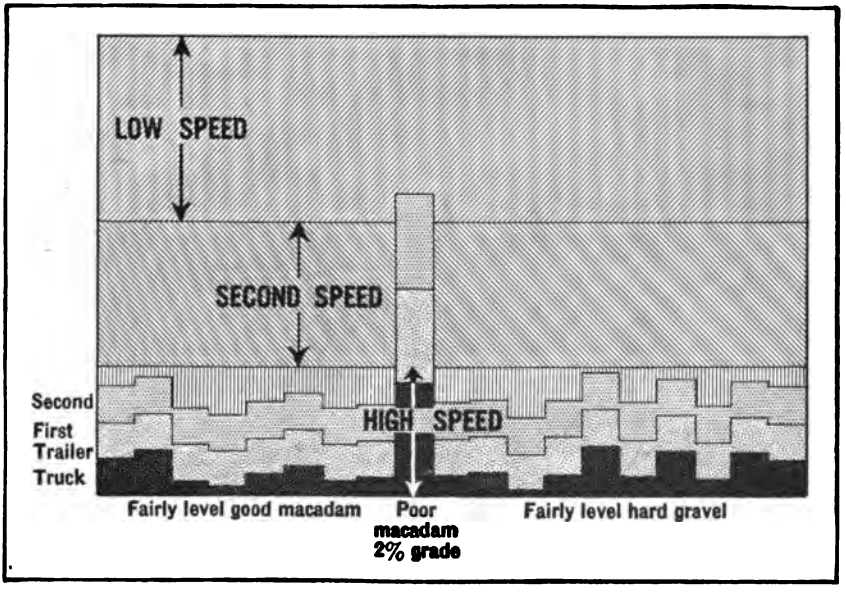


FIGURE 126: In this case the roads are fairly level and a truck with two trailers operates inside the high-speed zone—except at one stretch in the road, which we may assume is so short in comparison to the entire trip to be almost negligible.

FIGURE 127: This coal has not been dumped into an overhead bin to facilitate loading by a gravity chute. Nevertheless a special loader of the type shown in Figure 79, scoops it from the ground and discharges it into the truck.

FIGURE 128: By being equipped with steel-flang.d wheels this motor truck is able to replace a switch engine. An improvised trailer made from an old set of car wheels serves as a two-wheeled trailer for carrying steel rails.

road conditions as those met with in the morning—that is, its maximum power is tested. The day's haulage conditions are plotted in the chart shown in Figure 123.

The peak at each end of the chart indicates more or less closely the maximum task which the truck is designed to accomplish. What, then, does the white space in between represent? Power gone to waste? Let us express it in those terms for the present. But, applying it to the subject we are discussing, it represents specifically the field of the trailer.

The Field of the Trailer. It is obvious that, during most of the day, one trailer having the same weight loaded as the truck, can be attached and hauled without exceeding the maximum power of the truck. This can be represented graphically by painting a second band on the chart which duplicates in width and outline the bottom band representing the performance of the truck. This is reproduced in Figure 124. It is clear that in no place does the combined load pass above the maximum line at the top except at the beginning and end of the day's work, where the trailer absolutely cannot be used. Other arrangements can probably be made at these critical points, however; for instance, the trailer can be picked up after the truck has climbed the 25% grade in the morning and dropped again before it starts to climb the same grade at night. Two trailers could not be hauled except over a small portion of the route.

This chart, however, is not complete. We have purposely left out of consideration the matter of change-speed gears. This has an important, and often a determining influence on the question of whether trailers can be used to advantage or not in a given haulage condition.

The Functions of Change-Speed Gears. The function of the change-speed gears is, briefly, to increase the leverage with which the engine acts upon the driving wheels of the truck. This is accomplished always at the expense of speed. The engine, we will say, develops a certain amount of power, which cannot be increased beyond fairly definite limits. Suppose the truck passes from a brick pavement to a muddy unpaved road. Five times as much power is required to propel the truck under these conditions. Where is this additional power coming from? Most of it must be supplied by increased leverage. Gears are merely levers, made in circular form for the sake of compactness. By making these gears, and hence the engine

also, turn over four or five times as often as before for every revolution of the driving wheels, the tractive force or the push with which these driving wheels act on the road can be increased correspondingly, but the speed is correspondingly reduced.

Let us consider that a five ton truck can haul a capacity load at 12 miles an hour against a combined resistance of road and grade amounting to 150 pounds per ton. Between 150 and 300 pounds resistance it must drop into second speed, at seven miles an hour. Above 300 pounds the truck must operate in low speed, which may amount to three or four miles an hour.

How Gears Affect Performance. Taking the chart shown in Figure 124 we will draw three bands or zones across it, representing the work which can be done in high, second, and low gears. The significance of this will become apparent at once. Under certain conditions a truck can be operated at the same speed when hauling a trailer as when traveling alone. Under other conditions both truck with trailer and truck alone must descend into a lower speed. Under still other circumstances, the truck alone can operate at a high speed, but with trailer attached must descend into a lower speed. In Figure 125, for instance, under conditions A, B, and C, truck with trailer attached operates at the same speed as truck alone; under condition D both descend into second speed; in case E, truck alone travels at high speed, but with trailer attached must descend into second. F is like A, B, and C, but in G and H the truck operates in second speed, but with trailer attached must descend into low speed.

It is obvious that the speed with which a truck or a truck and trailer operate, has an important bearing on the work performed by each. For instance, if a truck operator hauls twice as much by the use of a trailer but only half as fast as with a truck alone, his total ton mileage for the day is not increased.

From these considerations the reader will see that the ideal conditions for trailer use are those of level roads and good pavements. This, however, is merely the ideal condition. The chart in Figure 126 shows excellent haulage conditions for trailers. The grades do not exceed 2% and the road resistance is constant at fifty pounds per ton. The owner has attached just enough trailers to enable his truck to make use of its high speed, all through the day except at one point.

CHAPTER XII

USING TRAILERS TO HAUL MORE GOODS

IN the preceding chapter we treated fully the question of how much a truck can haul in trailers under various conditions, and how fast it can haul it. That question is fundamental and must be answered before the truck operator can determine the relative economy of using trailers as compared with trucks without trailers in his business. He must analyze his haulage conditions with respect to the resistance offered by road surfaces and grades, and determine from that analysis what loads his trucks can carry and at what rate of speed.

Let us suppose that the business man has made that analysis and as a result has before him the two factors of load and speed which he may expect from the use of trailers. From this information it is an easy matter to determine ton-mileage. But, as we saw in Chapter IV, the one item—cost per ton mile—is the final figure sought for, by which the absolute cost of truck transportation is measured, as well as its relative cost in comparison with horse-drawn trucking or any other form of freight hauling with which the system in question is competing. What is true of motor truck accounting is, of course, equally true when trailers are used. The next step, therefore, is to determine the cost per ton-mile of haulage by trailers, and compare it with the cost per ton-mile of transportation by truck alone.

Figuring the Cost of Trailer Ton-Mileage. How this is calculated may best be made clear from the following example:

A contractor, using a 5-ton truck without trailers, figured on an average daily performance of 110 ton-miles. The average daily cost was $16. He divided his costs as shown in the upper portion of Figure 129. His cost per ton-mile was nearly 15 cents.

He bought one 5-ton trailer, which his truck was well able to haul in addition to its regular load. He discovered at once

that he had doubled his load. He found out, however, that he had not doubled his daily ton-mileage, but instead had increased it by 85%. Where his ton-mileage was formerly reckoned at 110, it now reached 203.

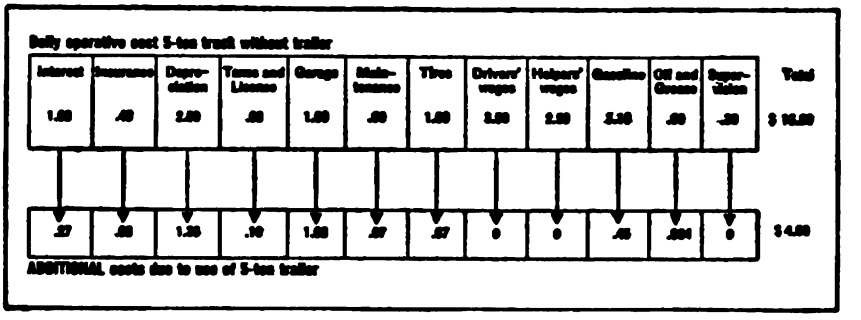


FIGURE 129: What is the *additional* cost for hauling a trailer? Not double, because some of the items of truck operating cost remain the same—driver and helper, for instance. Other items are increased only slightly, as this chart shows.

Let us see what prevented him from doubling his daily ton-mileage. In the first place, it was necessary to load the trailer as well as the truck, and this increased his total standing time for the day by twenty minutes. Then there were two or three stretches of road presenting a combination of poor macadam surface with a 3% grade. Formerly his truck had made this on "high," but with the trailer behind, it was necessary to reduce the speed by half. The total loss in time, however, was only 30 minutes. Altogether, he found that he made five trips less per day than formerly. The performance in ton-miles of the truck and trailer and that of the truck alone can be represented by the following:

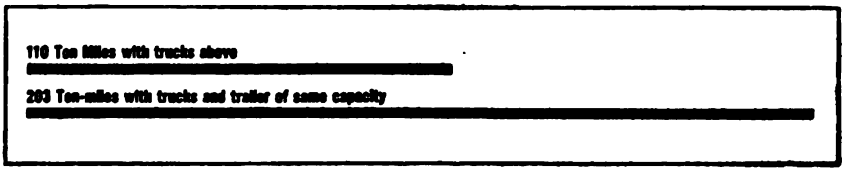


FIGURE 130: Even when you use a trailer having the same capacity as your truck you do not quite double your ton-mileage, for speed is bound to be reduced somewhat; then there are slightly increased delays in loading, and unloading.

The Cost of Trailer Maintenance. The contractor next turned to the matter of costs, and here he made some valuable

discoveries. Taking one by one the items of truck expense, and applying them to the trailer, he found that they were greatly reduced. As the trailer cost only about one-fourth as much as the truck, the daily interest charge for the trailer was only one-fourth as great, or 27 cents a day. Insurance was even less, not only on account of the lower valuation, but also because liability insurance for trailers is computed at a lower rate than for trucks. Depreciation was figured at 20%, but an additional amount was added to take care of slightly hastened depreciation of the truck which hauled the trailer. Taxes and license fees totaled about half that charged against the truck. Garage rent was included at the same rate as for the truck, but maintenance amounted to only one-eighth the truck figure, due to the extreme simplicity of the trailer, the absence of complicated mechanism, and so on. Tires were a third less because the trailer, although of the same carrying capacity as the truck, was much lighter, due to the absence of a power plant, gears, and the like. Moreover, as none of the tires performed any tractive effort, they gave longer service. On the next five items the trailer showed an enormous saving. Drivers' and helpers' wages were absolutely eliminated. A charge for gasoline was figured on a basis of 15%, as it was found that on good going the truck showed very little extra consumption of gasoline in hauling the trailer. Grease only was used on the trailer, so the entry under "oil and grease" was only $0.004. The item of supervision was eliminated.

Trailer Saves One Third in Delivery Costs. The contractor was now in a position to determine whether the use of a trailer in his business spelled economy or not. He found that although his ton-mileage had not yet been doubled, as he had secretly hoped it would be, neither was his cost of operation doubled, and of the two, ton-mileage increased by a much greater percentage than costs. Formerly it had cost him $16 to deliver a ton-mileage of 110; with a trailer attached it cost him only $4 more to perform 93 additional ton-miles. Formerly his cost per ton-mile was 15 cents; by the use of a trailer he reduced it to 10 cents, a saving of 33⅓% in his transportation bill!

Severe Tests for Trailers. This contractor's haulage conditions were extremely favorable for the use of trailers. He had long hauls with few stops, fairly level roads and fairly good pavements. Suppose, however, that he had to contend with conditions described in any of the three cases which follow.

Case I. A round-trip haul of ten miles, 5% grade, five miles long over ordinary dirt roads, capacity load for truck and trailer.

Case II. A round-trip haul of ten miles, capacity loads, over frequent 1% grades, roads surfaced with soft clay.

Case III. A round-trip haul of ten miles, level brick road, except one 20% grade one-half mile long, over ordinary gravel road.

In the first case, the truck with trailer attached would have to run in second speed during half of the trip. While the tonnage carried each trip would be doubled, the number of trips would be reduced, giving a net increase of daily ton-mileage by the use of trailers about 33⅓%. His expense, however, would increase by about the same amount, with the final result that, although he doubles his load-carrying capacity, he has not reduced his ton-mile cost a single penny.

In the second case, assuming that the entire trip is made over poor clay roads, the truck with trailer attached would have to run in second speed all the way, whereas if no trailer were used, the truck could probably make the entire trip on high gear. The result would be, no increase whatever in daily ton-mileage, but an increase in operating costs, which would occasion a net loss to the contractor of $4 or $5 a day in comparison with what his expense would be if he operated the truck alone.

In the third case conditions show not so much the inadvisability as the impossibility of using a trailer. The 20% grade cannot be surmounted by the average truck with loaded trailer of the same capacity behind. The contractor must either make a detour around this hill, or give up altogether the idea of using a trailer on this route. It is apparent that under these conditions a trailer is impracticable, though not impossible.

Where Trailers are Unprofitable. But it must be realized that these cases were selected with the purpose of showing under what conditions the use of trailers is not likely to prove profitable to the truck operator. They are, therefore, exceptional and not representative. It is not often that a truck is required to climb a 5% grade five miles long, or travel for ten miles over poor clay, or surmount a hill with a 20% incline. Yet every truck meets these kinds of conditions to some extent, and inasmuch as they influence directly the capacity of the truck to pull loads, they must be studied and applied to each individual hauling problem in order to determine whether trailers may be used profitably or not.

So far we have considered the trailer with reference to the ability of the truck to pull it, and have reached the conclusion that the ideal conditions for the use of trailers are level roads and good pavements. How nearly level the roads should be or how good the pavements, is determined by an analysis of road and grade resistance, and tested by an accounting which gives us the final proof of our problem: the cost per ton-mile.

It so happens, however, that the use of the trailer often makes possible several unique economies which may not be apparent to the business man who works the problem out on the basis of load, speed, and road resistance.

Are Trailers Economical for Short Hauls? It has often been said that trailers are suited to long hauls, but cannot be used successfully in congested districts where constant starting and stopping is necessary. A contractor was engaged in excavating for a large office building in the heart of an eastern city. At first he employed a 5-ton truck without a trailer, but later bought a 5-ton trailer which he intended to use at night when the streets were clear. He found, however, that under the haulage conditions which he had to contend with, the trailer cut down the speed of his truck nearly half. As an experiment he used the trailer by day. He discovered that his daily tonnage hauled was nearly doubled, for although the trailer reduced the speed which the truck was rated to deliver, it did not reduce it below the speed of street traffic; that is, the truck ran at the same speed by day time as formerly, but hauled twice the load.

The adaptability of the trailer to diverse haulage conditions is, indeed, one of its principal qualifications. Let us consider some of the more important ways in which trailers can be used to cut the cost of motor truck transportation.

We have shown, in Chapter VIII, that the time spent at the loading point constitutes perhaps the most serious delay encountered in the operation of the motor truck. This delay often cannot be avoided, because, in the nature of things, it takes time to load a truck properly, especially when the merchandise handled is in small units.

If, however, an extra trailer is used, together with a demountable body for the truck itself, they can be detached from the truck and left at the loading platform while the truck is busy on the road, hauling another trailer perhaps and making deliveries. The loading of the extra trailer and body can be carried on as

carefully as you please, because the motor truck itself is not being held up—its time is not being wasted. When the truck returns, it takes but a minute to unhitch its empty trailer, change bodies and attach the loaded trailer which is waiting for it. In this way it is possible to keep the truck busy on the road practically all day, the only "time out" being that required to change bodies and trailers.

The Trailer Almost a Demountable Body. Considering this use of the trailer by itself, it is seen to be closely allied to that of the demountable body; in fact, it is a "demountable body on wheels." And from it advantage is derived, for no chain-falls or system of overhead tracks is required either to suspend the trailer or to move it about from place to place. Thus trailers can be used where it is often not practicable to install apparatus for handling demountable bodies.

In much the same way the trailer can be employed to cut down standing time at the unloading point. Let us suppose that a load of outgoing freight has been sent to the freight station. If a truck merely is used, it may have to wait an hour or even longer before its load is taken off by the freight handlers. This delay costs real money, for the time of the truck is valuable, being worth more perhaps than that of three or four drivers put together. Now if the load has been put in a trailer, this vehicle can be detached and left in charge of a helper, until the unloading has been completed. (Figure 132.)

Here again the trailer has the advantage over the demountable body in that no apparatus is required to hoist or move it. It will be apparent, moreover, that it would be much more difficult and impracticable to install such apparatus for handling demountable bodies at a delivery point than at a concern's own loading platform. In another chapter we cite a case in which a concern installed a chain-falls at an unloading point, but this was justified inasmuch as all of this concern's product was delivered at that one unloading point, a condition not commonly met with.

Bulky Loads Easy for Trailers. Besides acting as a quick loading or unloading device, the trailer often serves an important use by reason of its ability to handle bulky or oddly shaped loads which the truck itself could not carry. Here the matter of tonnage is often secondary, while space is of prime importance. Take the matter of empty barrels, boxes, or containers of any kind. Such "empties" have but a small fraction of their weight

FIGURE 131: Adaptability is one of the prime advantages of the motor truck, and it would be difficult to mention a hauling problem to which it cannot adjust itself. Here you have an instance. Of course, horses and a wagon could perform the task, but think of the confusion, delays, cost, and the dangers.

FIGURE 132: Loading may take up too much of the driver's time, but by the use of trailers of the above type the loading may be done by less expensive help while the truck is delivering, thus enabling the driver to make more trips per day.

FIGURE 133: Space, not power alone, is required to haul this huge boiler. The trailer is an indispensable aid to the motor truck in transporting bulky, unwieldy objects, which often could not be carried on the truck body alone.

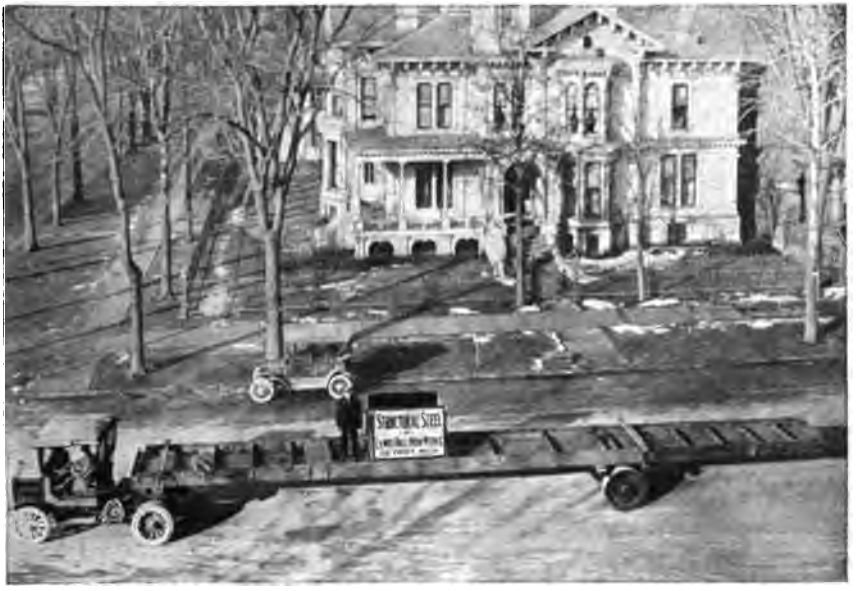


FIGURE 134: A steel girder is something more than a heavy load—it is an unwieldy load. The trailer solves the problem perfectly, taking care of both weight and length of load with ease and greatly simplifies the problem of transportation.

FIGURE 135: Note in the figure how easily some two-wheeled types of trailers may be maneuvered in "tight" places. In this case the platform of the trailer is high enough to allow the truck's rear wheels to "jackknife" under it.

FIGURE 136: This picture was taken in a dense forest in Washington, where motor trucks are rapidly coming into popular use in the logging industry. This truck is equipped with a power winch for hoisting logs onto the trailer.

FIGURE 137: Here we have another instance of the work motor trucks are performing in the logging regions. In this instance the semi-trailer has been called into play. The "trailer" is merely a pair of wheels joined to the truck by a pole.

when full, but they take up just as much room as ever. It is not economical to haul such loads in a truck, because the carrying capacity of the truck and its pulling capacity are largely wasted. The trailer, cheap and roomy, and easily attached to the truck, solves the problem.

Sometimes tremendous loads in one piece must be hauled, such as dynamos, steel girders, or huge boilers, which are not only large but heavy as well. Now one thing is certain, and that is, no matter how much a truck can *haul*, its carrying capacity is fixed, and cannot be exceeded without danger of injury to the truck. The springs alone sharply limit the load, and other parts suffer from an added weight as well. For hauling such tremendous loads, therefore, the trailer, specially constructed, provides the only way. Here speed is generally of little consequence; the problem is not how fast we can haul the load, but can we haul it at all? A motor truck cannot carry a 30-ton boiler. A trailer can. (Figure 133.)

Trailers in Lumber Camps. In the logging camps of the Northwest, trailers are putting the single track forest railroad lines out of business. Logs forty or fifty feet long and weighing several tons each have been loaded on trailers and hauled over forest roads without any difficulty. It has been demonstrated that loads as high as eighteen tons in weight can be carried on a 5-ton truck and trailer, and that the additional gasoline required has averaged a gallon and a half a day. One logging company used a trailer in connection with a 3½-ton truck and found that it could haul as much as eighteen tons at a time. The difficulty which many loggers experience, that of making the trailer track with the truck and follow the road without cutting in at the turns was obviated by means of a special steering apparatus which made the trailer follow the path of the truck perfectly. A power winch is made use of in hoisting the heavy logs on the body of the trailer. (Figure 136.)

Examples could be multiplied without end showing the versatility of the trailer in handling bulky or heavy loads. In Detroit, recently, a truck and trailer hauled a steel girder sixty feet long and weighing fifteen tons. (Figure 134.) As we have shown, huge boilers, weighing from twenty to forty tons have been hauled by a single truck and trailer. Telegraph poles, long pipe, lumber, bulky and heavy machines, and other objects either having great size or weight, and which could not be

carried by motor trucks, have been moved with the aid of trailers without mishap.

Delivering Mixed Shipments by Trailer. A wholesale concern in Los Angeles uses a trailer in connection with its truck when it is necessary to ship at the same time two commodities of such a character that they could not be loaded together on the same truck, such as ice and slaked lime. Formerly a mixed shipment of this description required either two trucks to carry it or made two trips by one truck necessary. The truck drops the trailer at some particular freight shed and then proceeds to deliver its own load—either to another freight shed or to some retail concern in that part of the city. After it delivers its load it picks up the empty trailer for the return trip, which makes the haul doubly profitable.

From this consideration of the trailer as a means of carrying heavy or unusual loads, a fourth advantage in its use becomes apparent: the trailer is often of great assistance to the business man in selecting the right truck for the work in hand.

Let us suppose that a merchant has loads to haul which average three tons, but that every Saturday, for instance, he receives a shipment of a machine or other heavy object which weighs 5 tons. What truck shall he select for his work?

If he chooses a 3-ton truck, he will overload it at least once a week, and overloading is dangerous. If he selects a 5-ton truck, in order to take care of his maximum load, he will have on his hands a machine which five days out of six he uses at three-fifths of its capacity. The increased overhead expense of operating the 5-ton truck where for most of the time a 3-ton truck would be adequate, represents sheer waste. What shall the business man do?

The answer is: use a trailer. And here it is of little consequence whether the trailer with its load can be hauled as fast as the same load on a 5-ton truck. Ton-mileage, for the moment, is not a factor, because the trailer has already effected an enormous economy by making it possible for the merchant to get along with a 3-ton truck, where otherwise he would have had to maintain the much larger investment.

What Type of Trailer to Buy. Having considered the principles which underlie the use of trailers, and having pointed out both the disadvantages and the advantages of this phase of motor truck transportation, let us glance for a moment at the

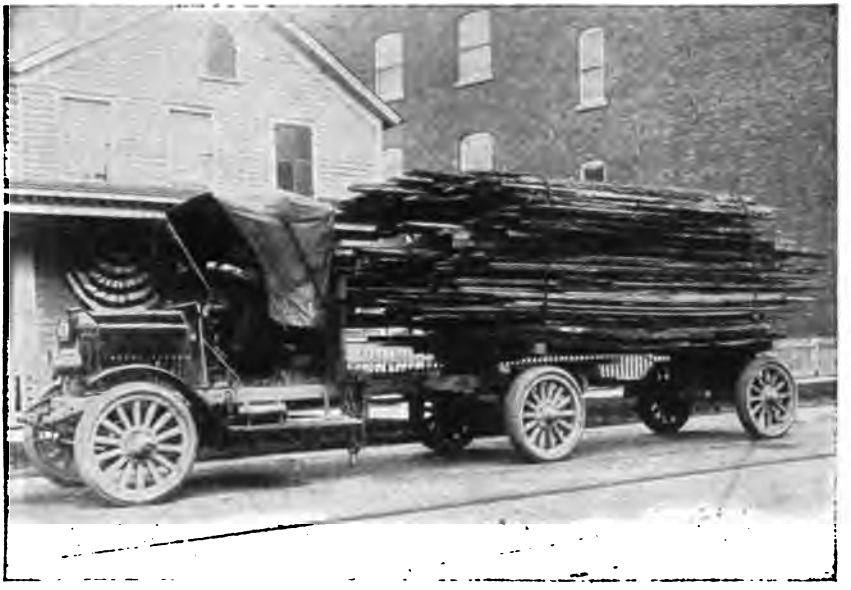


FIGURE 138: This semi-trailer provides just the right amount of additional space necessary to carry this load of lumber. The boards are too long for the conventional truck body, and are unevenly packed, thus offering an awkward load.

FIGURE 139: This four-wheeled trailer is a wagon built to the strict specifications of automobile construction and equipped with rubber tires, truck springs and axles, hardened steel bearings, spring bar attachment, and special steering device.

FIGURE 140: The semi-trailer may be described briefly as a wagon having rear wheels only. The front end is placed over the rear wheels of the truck. Compactness and ease of maneuvering are its strong points.

FIGURE 141: This two-wheeled trailer is not so much a distinct type as a makeshift, but it is a very useful one—cheap, light, and readily attached to the truck. It is especially adapted to light passenger cars or runabouts.

FIGURE 142: Whether loading or unloading, the trailer is a time saver. Merely detach it from the truck, and leave it to be loaded or emptied, and call for it when the job is done. In this case hinged struts serve for front wheels.

FIGURE 143: On a level, hard surface, trailers are easily handled, as this illustration would indicate. It is when the grades become steep and the roads rough, that the resistance increases amazingly. Then careful figuring is necessary.

FIGURE 144: This electric truck is equipped with a special body and hauls long telephone poles without the aid of a trailer. Loading the poles is greatly simplified by the use of a power winch.

FIGURE 145: A traveling crane as shown here can be used to better advantage in loading a truck than a stationary one, for with the former it is unnecessary for the truck to maneuver for a special position.

various kinds of trailers. Trailers may be divided broadly into three types: the four-wheeled trailer, shown in Figure 139; the semi-trailer, Figure 140; and the two-wheeled trailer, shown in Figure 141.

The four-wheeled trailer is, essentially, a separate wagon hauled behind the truck. The semi-trailer is virtually a wagon, having rear wheels only, and rests with its front end on the body of the truck itself. It is, therefore, not a separate unit, but may be considered as part truck and part trailer, for the rear wheels of the truck act as the front wheels of the semi-trailer. The two-wheeled trailer is much like the four-wheeled trailer, but is generally much lighter.

Each Type Meets Special Conditions. Various claims are advanced for each type of trailer, and the merchant will do well to look into the special conditions of his business in order to determine which type is best suited to his requirements. In general it may be said that the semi-trailer makes for compactness and can be more easily maneuvered. Thus, as in Figure 135, the semi-trailer in turning doubles up like a jackknife, enabling the driver to manipulate it in narrow streets, driveways, lumber yards, coal yards and other places. This, of course, is of enormous importance where the truck must be operated in congested districts. The semi-trailer can be backed by the driver in much the same manner as a horse and wagon. Moreover, the load itself is used to increase the tractive grip of the driving wheels; thus the heavier the load, the heavier the weight on the traction wheels of the truck, although this weight is rarely more than 40% of the total load in the trailer.

In favor of the four-wheeled trailer, it is claimed that as designed at present it will track absolutely in the path of the truck and can be maneuvered almost as easily as the semi-trailer. Moreover, it can be readily attached and detached, and used as a demountable body without the necessity of jacking up the trailer. Again, by means of the drawbar attachment, shock-absorbing springs can be used which minimize the strains of starting and stopping. The same claims, of course, apply to the two-wheeled trailer as well. One disadvantage in the use of trailers, however, is the difficulty encountered in backing them up.

Pointers on Buying Trailers. Here are four helpful pointers which the truck operator will do well to take into careful consideration in buying trailers:

(1) Most important is the construction of the trailer itself. When the trailer idea was first tried out, it was thought that ordinary wagons could be used successfully. But the horse-drawn wagon is made to travel at an average speed of four or five miles an hour. When such a vehicle is hauled at a speed of 10, 15, or 20 miles an hour, strange things happen. Bearings, which were designed to stand wheel revolutions of 14 or 15 times a minute, burn out when these revolutions increase to 50 or 60. The lubrication system fails or the terrific impact of the road, striking blows 10 or 20 times as severe as the wagon was designed to stand, soon racks it to pieces.

Most trailer manufacturers have abandoned wagon methods of construction and have built their trailers along much the same lines as a truck—to stand truck conditions of load and speed.

(2) See that the trailer is equipped with brakes. As your truck coasts downhill, or travels on a level street for that matter, with a loaded trailer behind it, it has many times its usual momentum and is correspondingly harder to stop.

(3) See that it is equipped with rubber tires. The theory that any road vehicle going as fast as a truck, can do without rubber tires is proving to be a fallacy. Springs absorb the big bumps, but they are not responsive to the little shocks that occur hundreds and even thousands of times a minute. Moreover, steel-tired trailers are causing damage to roads and in return, road commissioners are ruling them off the city streets. Again, rubber tires will tend to prevent that dangerous side slip in going down hill, which, at best, in one of the disadvantages encountered in using trailers.

(4) Look to the construction of your truck. Certain trucks called "tractors" are specially designed to stand the severe strains imposed on them by constant use in hauling trailers.

Special Features to Look For. The following table showing the special features of design of the average tractor will show you what to look for in your truck if you expect to impose severe strains on it by the frequent use of heavily loaded trailers:

(1) Provision should be made for attaching trailers to the rear of the truck and this part must be very strong in order to withstand the violent and often sudden strains which occur in starting or accelerating the train. Powerful springs must be introduced to take up the shocks.

(2) Extremely powerful brakes are advisable, as ordinary brakes would be unable to hold a heavy train of trailers on a grade.

(3) Larger tires are required than would be needed if merely the weight resting on them were taken into consideration.

(4) Inasmuch as the engine in a tractor is run much of the time in low gear, unusually large cooling surface should be provided.

(5) Since the tractor is continually meeting grades or road conditions, requiring a reduction of gear, and inasmuch as the frequent shifting from a higher to a lower speed might mean a serious loss in total distance covered if these differences in gear were as marked as in ordinary trucks, intermediate gears are generally introduced. Also the first speed is generally made very low to take care of the extra strains which come when climbing a grade or in starting a long and heavy train of trailers.

Future of the Trailer. The trailer is here to stay. Every indication points to that fact. Not only are there thirty-odd concerns making trailers at present, but truck manufacturers themselves are turning their attention to this new phase of their industry and in some instances are preparing to build trailers.

It is generally agreed that under certain conditions of road and grade the use of trailers may effect economies which are enormous—representing a saving over former methods which may conceivably amount to as much as 1,000%. These conditions are becoming better and better understood, and where they obtain, men are buying and using trailers. From the contractor who hauls 36 tons of crushed stone at a clip in three enormous four-wheeled trailers, to the farmer who hitches a two-wheeled gig to the rear of his automobile and speeds away with ten cans of milk to the 3 o'clock train, business men everywhere are realizing that it is often more profitable to haul a load behind a truck than to buy axles, springs, wheels, and tires big enough to support that load on the truck itself. The principle is sound—the only difficulty is in its application.

Does the Trailer Damage the Truck? Two problems still vex the progress of trailer transportation. The first is: does the practice of hauling trailers damage the truck? This may be answered at once by saying that hauling trailers does increase the wear and tear on the mechanism of the motor truck. This is to be expected. But how much? This is a problem which bids fair to work out its own solution. For truck manufacturers, realizing the great economies which are often available by the use of trailers, are designing their trucks with a view to meeting the increased strains. They are providing larger radiators, larger brakes, larger tires, different gears, which will do much to solve this problem.

Anti-Trailer Legislation. The other problem has to do with legislation. In some cities drastic regulations are being made seeking to limit or even bar the use of the trailer, due to congestion. Under some conditions such action is justifiable. But on the other hand it must be remembered that the trailer carries with it the brightest hope of reducing this congestion by reducing the number of trips. Street cars, in the rush hours, are coupled together and operated as trailers. Truck trailers serve a like purpose. Moreover, the trailer brings with it the best promise for the maintenance of the roads, for it distributes its load over many axles, and thus reduces the crushing "total wheel weight" which is so often the cause of serious damage to our highways.

The trailer is an economical servant, carrying much and costing little. It is the big possibility in motor truck transportation today that will be realized tomorrow.

CHAPTER XIII

HELPING THE TRUCK TO UNLOAD EFFECTIVELY

PERHAPS the most important cause of idle time in the operation of motor trucks is the delay frequently encountered at the loading platform. We have shown that the truck owner, by cutting down this delay even an hour a day, may effect the saving of as much as $5, or more than the cost of the fuel for the day's trip may amount to.

In a similar manner the business man should attempt to reduce the delay which frequently occurs in the course of unloading. In this chapter let us consider specific ways of reducing the time of unloading, all of which have been tried and tested by truck owners in various lines of business.

It may be truthfully said that the problem of quick delivery has not caused the truck user as much concern as that of expeditious taking on of loads. The reason is obvious. Things can in general be much more easily taken down than put up. Such material as coal, gravel, and so forth, is of such a nature that it can readily be dumped, that is, discharged almost without any expenditure of time whatever. Some merchandise, notably dry goods and other goods sold at retail in packages, generally must be delivered piecemeal to separate customers, and no mechanical aids could alter that condition. It is interesting to note, however, a few devices and recent improvements which hasten even the naturally prompt course of average delivery.

The Dump Body. The dump body is the most important of all agents in the speedy delivery of a large class of rough and heavy merchandise. The ordinary dump is more or less familiar to everyone. (Figures 146 and 147.) The body is pivoted at a point near its delivering end, and in operation is raised at the other end by a suitable hoist, generally hydraulic, although the simple screw type of hoist is gaining considerably in favor.

It is sometimes necessary, however, to elevate the load before dumping. This is accomplished by means of a power hoist located midway on the chassis, which is driven by the motor and operates with powerful leverage on struts or beams which hoist the load bodily in air, at such an angle that no further tipping is required to cause it to dump. This is of special use to dealers in coal, who frequently have to deliver their load at a level considerably above the street. (Figures 148 and 149.)

Gravity Chutes. Perhaps one of the most troublesome conditions met with in delivering coal is that where the dwelling or building is set back so far from the street or the driveway that the ordinary coal chute is too short to span the distance. The coal man cannot remedy the trouble by adding on another chute, inasmuch as when extended to such a distance, the chutes do not possess the necessary pitch to permit a gravity delivery of the coal. This same condition is found in an aggravated form where the building to which the coal must be delivered is on a high bank several feet above the level of the street.

Some coal dealers permit their trucks to stand fifteen or twenty minutes while the coal is laboriously carried by hand in buckets or sacks and thrown in through the coal hole or basement window. This is expensive, however, and may conceivably add from fifty cents to a dollar to the cost of selling and delivering each ton, although the coal merchant frequently fails to collect this additional charge. A more effective manner of delivering coal under these conditions is shown in Figure 150. The entire body of the truck is lifted a distance of five or six feet by means of four screws, one attached to each corner of the body. These screws are operated by the engine. This makes it possible to run chutes a distance of thirty or forty feet if necessary to the delivery point and gives sufficient pitch to permit a rapid gravity delivery of the coal. In view of the fact that the body is not dumped in this case, it is necessary to build a gravity pitch into the bottom of the truck body so that the coal will feed naturally into the hopper and flow out into the chute. A gate at that point permits the operator to control the volume of the flow.

When the Use of Chutes is Impossible. Very often, however, a condition is encountered where the use of coal chutes is impossible under any arrangement, and it becomes necessary to carry the coal from the truck to the cellar in baskets. What is the most effective way of doing this? A Rochester coal company

FIGURE 146: The modern dump truck delivers its load in a fraction of a minute. The driver remains on his seat, pulls a lever, and the engine does the rest. A hydraulic hoist, a screw, or sometimes a train of gears delivers the necessary power.

FIGURE 147: The dump body is indispensable to the contractor who handles loose material that cannot be handled by this method of delivery. Note the column behind the driver's seat, in which the hydraulic hoist is contained.

FIGURE 148: A 14-foot sidewalk separates this truck from the window through which the coal must be delivered. Formerly the coal had to be carried in baskets; now the truck body is raised a few feet and dumps the load by gravity in two minutes.

FIGURE 149: This coal dealer laid planks which enabled his truck to back up over the curbstone, then blocked the wheels, elevated the body, and delivered the load in less than two minutes in spite of a sidewalk and a five-foot embankment.

FIGURE 150: The same principle as shown in Figure 148 is illustrated here, but it is worked out differently. The body is raised by four struts, and the coal is delivered into the chute through a hopper built into the bottom of the truck body.

FIGURE 151: In some cases it is still necessary to deliver coal in baskets. This truck has four spouts in the tailgate which fill the baskets in a few seconds. Then the "table" is raised, automatically bringing the baskets shoulder-high.

FIGURE 152: This side-dump body has many advantages, chief of which is that it can be dumped by hand pressure exerted through a lever. The body rests in balance, and after being unlocked, a slight shove is enough to dump it.

FIGURE 153: It was worth while to install this overhead crane on this truck chassis, because it solved the problem of unloading marble building blocks which were heavy, and easily damaged. In this instance hand-power is used.

has solved the problem by means of the specially designed body presented in Figure 151. The bottom of the body is pitched at the rear to 75 degrees. There are four spouts in the tailgate which can be opened to allow coal to flow out. A table is attached to the rear of the truck, on which four large baskets can be placed, each basket holding 198 pounds of coal.

When the table is in place with the baskets on it, the spouts are opened and the baskets filled. The spouts or gates are then closed and the table is elevated by means of a hydraulic hoist until the baskets are at the height of a man's shoulder. They are removed by the men without delay and the operation is repeated. The entire work of filling and elevating the baskets is performed in six or seven seconds, thus cutting down materially the time of unloading. In fact, this company states that the cost of delivering coal has been reduced from 52 cents per ton, which was the old horse and wagon average, to 32 cents with the trucks.

Unloading Sidewise. One condition of delivering loads, such, for instance, as gravel and crushed stone, which is often met with, is that of narrow alleys or any kind of narrow lane such as might be formed by a couple of freight cars at a distance apart of little more than the width of the truck. It is, of course, impossible to maneuver in such a space. A dump has been devised which delivers its load sidewise, as shown in Figure 152. A further refinement on this dump is to divide the body lengthwise into compartments, which permits of dumping part of the load to the left and part to the right. This does not interfere with the truck coming through the same path several times.

For unloading heavy objects which cannot be dumped, a truck may be equipped with a crane mounted on the chassis as shown in Figure 153. On a truck belonging to the New York City Bureau of Sewers, both the crane and dumping body are operated entirely by the motor. Such equipment will be found of advantage in handling such objects as heavy sewer pipes or iron castings or large blocks of marble, which have to be handled and set down with much care. One of the most interesting and perhaps the simplest dumping mechanisms which has been devised is that used by a Michigan contractor in delivering sand. The essential features of this dumping body consist of two flaps or wings, one on each side, which are connected by hinges to the upper halves of the sides and which are operated by a hand lever worked by the driver. In order to provide the necessary gravity

pitch the bottom of the truck body is built in a convex shape. The advantage of such a dumping device, of course, is its cheapness, inasmuch as it does away with the necessity for installing a hydraulic hoist or other power-operated mechanism. Thus it could be applied to wagons where the more expensive investment would not be justified. There are several types of this form of gravity unloader, but the underlying principle of all is the same.

Where the Gravity Pitch is Built In. Another rather ingenious dumping body is that indicated in Figure 154. Here the gravity pitch is already built in, so that with free flowing material such as gravel, it is merely necessary to open the tailgate to discharge the contents. Some contractors combine the dumping principle with this design of body which enables them to get sufficient pitch without lifting the body to any great extent.

We saw, in Chapter VIII, how lumber dealers were able to load lumber in a fraction of the time formerly required by fitting the truck body with rollers. These rollers are also effectively used in delivering the load. They are turned by long-handled cranks, and an entire load of lumber can be rolled from a truck in about a minute. This obviates the necessity of installing a more expensive dumping mechanism and performs the work just as satisfactorily. It is also more adaptable to the handling of lumber, inasmuch as these rollers can be installed on trailers where the extension of the body or the use of the ordinary dumping system would be difficult and impracticable. (Figure 155.)

Pointers About Gravity Unloaders. Truck operators, in making their selection of dumping mechanisms of the gravity type, should bear in mind that the character of the material which they expect to deliver has an important bearing on the design and pitch of the dumping body. For instance, material such as coke can be dumped by lifting the body to an angle of 23 degrees, while on the other hand, wet ashes will not flow freely by gravity until a pitch of 34 to 36 degrees has been obtained. The material of which the body is built also has an effect upon the readiness with which the contents of the body will dump. Wood not only wears quickly but it tends to cling to certain materials such as wet ashes or sand.

This very important information has been summed up in a table based on a series of tests by Mr. Morris A. Hall. The following gives the angles with the horizontal at which various materials can be dumped with a flared, steel-lined truck body.

FIGURE 154: Two principles of dumping efficiency are here illustrated. First, the body has a sloping floor, which provides sufficient pitch; second, the body is dumped by hand-power by means of gears, which are easily handled.

FIGURE 155: "Rolling off" a load of lumber is a money-saving method of delivering that material. The roller is roughened, so as to "take hold." The body has other rollers, smooth ones, which serve as idlers and facilitate the delivery.

FIGURE 156: Step number 1. The truck, with a special body, backs up to discharge its load. The body, by the way, has been loaded carefully by hand while the truck was busy making another delivery with *another* body.

FIGURE 157: Step number 2. The body, with its special frame, is being slid off the rear end of the chassis. Note the chains which prevent the body from tipping too far. It is essential that this body have no tailgate.

FIGURE 158: Step number 3. The body now stands vertical, and is ready to be lifted off. If there were a tailgate, it would have to be removed—a difficult operation. It is much easier to loosen the clamps at the bottom, which serve as a tailgate.

FIGURE 159: Step number 4. Then the clutching frame hauls the body back on the truck in just the opposite manner from that in which it dumped it in Figure 157. Note the tailgate clamp. Now back to the yards, for another loaded body.

FIGURE 160: "It isn't the fall, it's hitting the ground" that chips, mars and breaks fine face brick. This contractor has solved the problem by making his tail-gate extend to the ground. Note the chains, which must be just the right length.

FIGURE 161: Almost any material handled in bulk such as crushed stone, gravel, sand, cement or bricks, can be delivered to great advantage by a dump body. Here a five-ton load of forgings is being discharged.

Material	Angle
Dry ashes	33°
Wet ashes	34°-36°
Very wet ashes	29°-30°
Concrete or garbage	30°
Sand	29°
Broken stone, number 2 sand	27°
Soft coal	30°
Coke	23°

Unloading Brick Safely and Quickly. The unloading of bricks has always presented a problem of the utmost difficulty. While bricks may almost be considered as loose material, they cannot be dumped or delivered by chute without grave danger of chipping the edges and corners. Consequently contractors have been obliged to unload bricks by hand, except in the case of cobblestones, or of a very few cheap kinds where it is immaterial whether a few bricks become damaged or not. This occasions a considerable and expensive delay, and has served in many instances to discourage the use of motor trucks in that field of work.

Here are three specific ways of delivering bricks which avoid the usual dangers of dumping, or reduce it to a minimum. By the first method, a body is used which, upon being dumped, very nearly touches the ground with its rear end. (Figure 160.) When in this position, the tailboard is raised about five or six inches, and as the truck is started slowly ahead the bricks feed out very gently with practically no fall and are spread out in a long layer on the ground. An observer reports that recently he witnessed the unloading of 200,000 paving bricks in this manner, and could only find one brick broken in the process.

A second method makes use of shallow boxes, which have a depth of about 8 inches and are as long as the truck body. These trays are either removed by hand or are slid off with the aid of a dumping body. This method, however, is rather costly in time, inasmuch as the brick must be packed and unpacked by hand. Its chief merit is that it frees the truck for other work.

The Demountable "Hack" Body. The third method, and perhaps the most scientific and complete yet known, has recently been invented and involves the use of a demountable "hack" body. Each step is shown in the four views shown on pages 210 and 211. In Figure 156 the truck has backed up and is ready to dump the bricks. Notice that the bricks are packed in a "hack," provided with a simple clamp at the delivery end. A

clearer idea of this may be had by glancing for a moment at Figure 159. This clamp applies pressure only to the rear layer of bricks, which, held rigid, does the duty of a tailgate.

In Figure 157 the body is in the process of being dismounted (the necessity of the clamping device is most apparent here), and in Figure 158 the body is entirely dismounted, being set upon its end and completely detached from the truck. The clamp is now loosened, and the body hauled away by the truck, leaving the bricks standing in a perfect column, as shown in Figure 159, as though they had been carefully packed by hand.

Another Advantage of the "Hack" Body. But here another advantage becomes apparent. Since this is a demountable body, it can be left at the brick kiln or the side of the freight car to be filled, while a second body, already loaded, is swung on the truck. Thus all possible delays in connection with the handling of the bricks are eliminated; the delay of loading by means of the demountable principle, and the delay of unloading by the combination of veritical dump and tailboard clamp. In addition to the elimination of this delay, of course, is the further advantage that the bricks are kept in perfect condition and moreover are delivered in such a shape that they can be easily handled again.

Brick contractors frequently encounter the condition of delivering brick from a sidewalk to the middle of a street which is being paved. This is often taken care of by the use of roller gravity conveyors which deliver the brick directly into the hands of the workmen at the point where they are paving.

Special ingenuity is often required to solve practical delivery problems. A contractor in a western city was engaged in hauling a large number of marble slabs and other kinds of finished stone, to be used in the construction of a public building. He did not, at first, take into consideration the length of time which would be required to deliver this material, but he soon found out that it amounted to a considerable item. He found that if he attempted to speed up the unloading it resulted in damaging the stone. He hit upon the happy thought of building simple wooden skiffs in which the stone was placed at the loading point. This enabled him to unload the stone with great rapidity and with little or no danger of damage.

How Buckets May Simplify Unloading. One of the most interesting applications of the automatic dumping principle has

FIGURE 162: This truck can deliver loose material effectively to three customers on one trip. The body contains three dumping compartments each operated independently of the others. This also permits dumping on both sides.

FIGURE 163: Here is a truck that carries large loads and delivers small ones. The partition enables the body to dump the rear half at one point. Then it swings open as shown, to permit delivering the remainder at another point.

FIGURE 164: This dump body can be installed on any truck. It does away with a complicated dumping mechanism. The body rests in balance, and, after unlocking it, a slight shove is enough to make it discharge its load.

FIGURE 165: Here you have a "close-up" of a hydraulic dump hoist. The large cylinder contains a piston operated by the engine. The hoist is placed so that the body extends up to the seat, thus utilizing all the space possible.

FIGURE 166: Here we have what might well be termed the "versatile winch," which rolls heavy objects off the truck and rolls them on again. In this case a telephone company is tightening underground cable.

FIGURE 167: Thirty-six tons of crushed stone hauled by one motor truck! The truck is of the tractor type having a short wheel-base and unusually low gear ratios. The load is distributed over six axles and 26 tires.

FIGURE 168: Here the horizontal hydraulic hoist (referred to in Figure 165) has lifted the truck body to discharge the load. As the body is elevated the tail-gate is automatically opened. The driver need not leave his seat.

FIGURE 169: While most dump bodies deliver the load at the rear, a side-wise dump is sometimes indispensable. In a narrow street for instance, a load may be dumped on the sidewalk without the need of backing the truck.

been worked out by a Chicago concern which has achieved a national reputation for skill in hauling and delivering loose materials. (Figure 162.) Although dump bodies are commonly used with 5-ton trucks, this concern has worked out a series of small dumping buckets, sometimes amounting to the number of three or four on the same truck. These bodies may be of one, or even one-half ton capacity. If the coal dealer receives three or four separate orders, each calling for the delivery of only one ton of coal, he can load up all four of the buckets and deliver each load without returning to the plant.

Another ingenious device for unloading loose materials in separate lots is shown in Figure 163. The body of the truck is divided by a gate which may be closed or opened depending upon whether half of the load, or all of it, is to be dumped.

The tip-bucket style of body is much in evidence on trucks of all sizes. (Figure 164.) The 1-ton dump truck, which, two or three years ago, would have been thought impracticable, is now frequently seen on the streets. The principle of the tip-bucket form of dump makes it easy to operate, inasmuch as the body practically rests in balance and it is merely necessary to unlock the body and apply moderate pressure on one side or the other in order to make it discharge its load.

Dumping Bodies that Handle 36 Tons. At the other extreme, dumping bodies of enormous size have been made and are being used by contractors who have a great deal of material to move. In Detroit, the Dunbar Stone Company has mounted three enormous bodies on trailers (Figure 167), each body carrying 12 tons and the whole load of 36 tons being hauled by one truck. In fact, bodies of this type are especially suitable for use on trailers inasmuch as they can be dumped by hand, no elaborate dumping mechanism being required. Owners of small trucks can also take advantage of this principle, inasmuch as dumping bodies can be installed on trailers without any additional expense besides the cost of the body and its installation. It is, however, by no means necessary to install a power hoist for the raising of bodies employing the familiar end-dump principle. Figure 154, shows a lifting mechanism which can be operated by a person of ordinary strength with a hand crank. It may be said, however, that the installation of such mechanism is not appreciably less expensive than the automatic lift operated by the engine, and is considerably slower in operation.

Roller Gravity Conveyors. Where units of uniform size are being delivered, it is generally possible to make use of roller gravity conveyor. (Figure 309.) A large bottling concern in a Texas city makes use of a roller conveyor track for unloading its cases of bottles. This track has side rails which prevent the boxes from rolling off. The owners find it possible to unload a cargo of cases in half the time required when they are taken off by hand. A conveyor of this type has also been successfully used in unloading dairy products, boxes of soap, cereals, and other packages handled by grocers. It would be impracticable however, to use a dump body for these commodities.

We have already mentioned the crane which is mounted on the truck chassis and is used to unload heavy objects. The power-winch can often be used for unloading purposes and, in such service, shows a surprising versatility. It can be used to haul off very heavy objects in the absence of a crane or other lifting mechanism. Its range of usefulness is remarkable. A telephone company in a western state makes use of the power-winch, not only to unload telephone poles, but even to set them up in the ground, and to lay and tighten cable. (Figure 166.)

Among the most important aids to the unloading of trucks, we must list again the demountable body and the trailer. These devices do not assist the actual discharging of a truck's load, but they aim, rather, at preventing the holding up of a truck at a busy terminal station, while waiting, for instance, for the unloading of mail sacks, or outgoing package freight.

The Main Advantages of Demountable Bodies. It is generally more practicable to use demountable bodies to speed up loading than unloading. The reason is that some apparatus must be installed to suspend the extra body, and while this is not expensive, it is obviously unwise to install it at several delivery points. Some concerns, however, who make several deliveries to the same point, have found it worth while to install chain-falls even on premises owned by another. This was done by The Curtis Publishing Company, whose installation is described elsewhere. Their trucks, which carried mail sacks, were kept waiting sometimes as long as an hour and a quarter before their load was removed. They installed chain-falls at their own expense, and this very considerable delay was at once wiped out. Very much the same result, of course, could have been obtained by the use of extra trailers.

In connection with of terminal delays, one of the best suggestions that has yet been made is the following: A type of standard body is made which will fit any 3- to 5-ton chassis. These bodies are of uniform size and uniform value and are interchangeable. The terminal companies suspend these bodies from chain-falls, and when a truck arrives equipped with one of these standard bodies, with a load that would naturally take considerable time or at any rate suffer a delay in the loading, that truck is permitted to leave its loaded body at the terminal and take back an empty standard body in place of it. This scheme is being used successfully in Cincinnati, and is worthy of more extended applitation at other railway terminals.

From the foregoing description of the funamental unloading devices it will be seen that the motor truck of today does not lack for number of appliances for assisting and hastening the delivering of its load. The economy of using these means wherever possible is tremendous. The waste from neglecting their use is also tremendous. Furthermore, the potential loss resulting from doing without motor trucks altogether when they could be used with profit by the installation of simple devices, similar to those sketched in the preceding pages, should not be long continued by progressive business houses.

CHAPTER XIV

HOW TO GET YOUR DRIVER'S COOPERATION

PERHAPS no problem connected with the operation of motor trucks is more baffling than that of getting the cooperation of the truck driver. Many authorities consider that the question of drivers is the crux of the motor truck problem. Mechanical difficulties have been and are being surmounted, but the difficulty which goes back to human nature is much more evasive and consequently requires subtler treatment.

Between your truck and its efficient use the driver may stand like an obstacle that cannot be moved. It doesn't matter how expensive your machine may be, or how skilfully you have laid your plans for its use, if the driver be minded to neglect your truck or your instructions or actually to work against them, investment and plans come to nothing.

Why the Driver's Cooperation is Necessary. The position of the driver is unique. In most business activities it is possible to delegate labor to subordinates without at the same time giving into their hands the power of deciding important matters of judgment. It is not so with the truck driver. A minute after he has received your instructions he is out of your sight. After he has turned the corner he is beyond your supervision. As he sits in his seat guiding the destiny of your investment, which may vary from one to six thousand dollars, he is, as it were, an ambassador plenipotentiary, an envoy given full powers of discretion and judgment. He is in full control. Your judgment is replaced by his judgment, and your investment, often an expensive one, may suffer accordingly. This is the fundamental difficulty in the problem.

To this difficulty, however, are added others scarcely less important. The automobile, carrying a complicated and swiftly working engine at great speed over all kinds of roads, has been

regarded as one of the engineering marvels of the age. The motor truck, which was not started until the passenger car was well along in its development, merely extends the marvel. To the problems met in automobile construction it adds the great difficulties of heavy weight and often of solid tires. These features of truck design complicate the problem because of the necessity of greatly reducing its speed.

Engineering problems involved in the loaded motor truck are unlike those in almost any other kind of construction. The skyscraper, the railroad train, the turbine in an ocean liner, the bridge, the tunnel, almost every form of engineering is surrounded by conditions of stress and strain which are well known in advance and which are confined within fairly definite limits. In the operation of the motor truck, however, the ever-changing surface of the road provides a variant so enormous that it would be impossible to calculate and design to take care of it without making a machine "monstrous in weight and extravagant in price."

Driver's Control Almost Absolute. A stretch of rough road may suddenly increase the strains which are at work on a truck to three or four times the normal. Let the driver overload his truck and these strains may amount to seven or eight times the normal; let him also overspeed and these strains may increase to ten or even twenty times those ordinarily encountered. Nothing in engineering can take care of such a wide range of strain. Practically there is no mechanical protection against overloading and overspeeding.

As we analyze our problem, then, we find that, to begin with, we must hire a man at an ordinary wage to take complete charge of an expensive investment, and that for the greater part of the time he is removed from the oversight of his employer. We find, further, that he is in charge of a vehicle subject to strains which, according to road, load, and speed, are of such varying magnitude that the constant exercise of skill and judgment is required to protect the truck. In addition, he must become skilful in the management of the clutch, the selection of gears, in the overhauling and general upkeep of the truck as a piece of machinery, including its lubrication. One might also include his behavior as a representative of his house, which is also a very important and vexing question.

Difficulties of the Problem. Having stated our problem in its simplest terms, let us see what can be brought forward to

solve it. How can we get the cooperation of the truck driver?

First in the list of suggestions may be mentioned the selection of the driver. This indeed may be regarded as a preventive rather than a cure—it is the stitch in time that saves nine. To be able to select material which will make good drivers is at the same time as difficult as it is desirable.

Obviously there are no fixed rules for guidance in this matter. The problem is as difficult as human nature, and no one can say with assurance, "This man will make a good driver, while that one will not." It is possible, however, to indicate what certain shrewd business men have done and to derive assistance from it. So far as it is possible to indicate a tendency in the matter, it has been in the direction of choosing men of caution, even age, instead of dash and youth.

The reason goes back to the conditions which surround truck operation, mentioned above. With the conditions present of weight, speed, and uneven road surface, forces are at work which, if not controlled, may develop accidents. What is needed is a restraining hand on the throttle. Better to go too slow than too fast. The problem which is hard for engineering to solve is not easy for the truck driver. As we shall show in Chapter XXI, doubling the speed increases the blow four times. Certain road obstructions strike like a sledge hammer, and may break spring or axle. The problem demands close observation.

Moreover, driving a truck is not a heroic job. Its speed is limited even under the most favorable conditions. Unlike the passenger car, which because of its lightness and its pneumatic tires, will stand considerable abuse, the truck must be humored and its speed continually reduced whenever rough roads are encountered. The impatient and headstrong driver, or the chauffeur trained to the greater speed of the touring car, is reluctant to work his way along at a reduced pace. His instinct is to "put her through" and "damn the torpedoes."

How Some Concerns Pick Drivers. So strongly do certain business men appreciate the quality of caution in the driver that many of them prefer to take teamsters and teach them the whole job of driving, rather than make use of men already acquainted both with the driving and the mechanics of cars. One of the large storage companies of Philadelphia is a case in point. In selecting drivers for their vans, they prefer to rely on their old, trusted employees, educated in their special line of work, rather

than professional chauffeurs unaccustomed to the conditions peculiar to their business. Some concerns go further still, and hire none but gray-haired men for their work; many insist on their drivers being married.

The truth is that driving a truck involves a responsibility which compares with that of a motorman or the engineer of a train. Caution, judgment, the qualities which come with age or a settled position in life, are desired. The dash and vigor of youth are not only not needed, but they are often a menace.

What an Expert Has to Say. The manager of a large fleet of oil trucks gave his opinion on the question of selection of truck drivers as follows:

"The most important factor beyond doubt, as far as the operation of the truck is concerned, is the selection of the driver. It is poor policy for the company to try to economize here by arbitrarily limiting the salary it will pay a driver, if the man it can secure for that amount has not the brains or interest in his work to take proper care of the truck. By spending two or three dollars more a week on the driver's salary the company would get a much better class of man, who could be entrusted with this form of investment.

"For the company which has recently motorized its delivery equipment the question will come up at the start as to whether it should use the drivers of its horse-drawn vehicles, who are acquainted with the oil business and its own marketing methods to operate its new trucks, or whether it should let these men go and secure drivers who know how to take care of a truck, but know nothing of its business. There is no question but that the former class is much to be preferred, provided they are experienced truck operators. On the other hand, the company motorizing its delivery equipment cannot afford to let a driver experiment with a new truck at the same time the company is itself experimenting with this kind of delivery equipment, with especial reference to correct operation and maintenance. If the tank wagon driver can be broken in gradually on a truck under a competent instructor there is every chance for him to become an able truck driver, knowing the oil business as he does. Usually the man who shows mercy to his horse, and is a successful driver of a tank wagon, will, if properly broken in, make a successful truck driver. The great danger is in putting a tank wagon driver, no matter how good a man he may be, on a truck of which he has no knowledge at all, without sufficient breaking in. The chances are the truck, which is an expensive piece of machinery, will be badly damaged in some form before he becomes a proper driver. This risk is usually up to the user in making the proper selection of the man to be entrusted with this form of rolling investment. Obviously much can be learned by sizing up the applicant for the driver's position.

"In hiring drivers, it is well to consider whether the applicant is well physically. A nervous or high strung individual is apt to take his temperament out on his car. A man has to be well and of a good constitution to stand the odor of gasoline and the heavy outdoor work entailed in driving a tank truck fifty-two weeks in a year."

Further Precaution to Take. But investigation should not end with the mere sizing up of the applicant. We are reminded that the position of the truck driver is one of great importance and that upon his proper selection may depend the profit and the safety of the transportation system, whereas, his improper selection may lead to losses by accident and in fact toward the total breakdown of the system of truck transportation which in every other particular may be soundly planned. After first looking over the applicant, therefore, a searching investigation should follow to learn whether the man seeking the job has ever had any accidents and how serious they were and what the causes were. It is well to find out if possible if the applicant has any defects in hearing or vision which might handicap him in driving a truck. No man who uses intoxicating liquors should be considered. Smoking on duty should not be tolerated. Moreover, he should be questioned to learn whether he understands the meaning of "Safety First."

The employer should consider also that the truck driver is a man who is going to represent his company to a good share of the general public, and it should endeavor to secure a man who appears level-headed and who can converse intelligently with customers and, if necessary, take their orders accurately, and who is courteous as well as able to handle his truck competently.

Educating the Driver. Important as is the matter of selecting the proper material for truck drivers the employer can never be absolutely sure that he has chosen the right man for the work. While he may have used his utmost skill in sizing up and investigating an applicant, he must place his chief reliance upon the manner in which he instructs and governs the driver after he is in his employ. In fact, instruction plays an invaluable part in getting the cooperation of the truck driver. There is much to be taught in the art of driving and taking care of the motor truck. Moreover, the average driver is eager to learn, if only the employer shows a disposition to teach him.

The publishers of *Motor Trucks of America*, an annual handbook on motor trucks, wrote to all of the truck manufacturers recently asking them what subject they would like to see treated in the introductory article. An overwhelming majority of the replies indicated that the most pressing problem which the industry had to face was that of preventing common abuses such as overloading and overspeeding. The publishers were

glad to accept this commission from the industry, and set about the task of investigating the subject at once. The editor in charge of this work was surprised at first to see the considerable amount of material which had already been written on this subject. On every hand he saw articles on the subject of overloading, overspeeding, and other abuses. These ranged all the way from paragraphs in newspapers to full length articles in magazines. In addition there were resolutions, and tags, and warning plates and penalties, and all sorts of signals calculated to drive home to the truck operator the pregnant fact that overloading is bad, overspeeding is bad. And yet the urgent command came, "Educate the operator on the evils of overloading, overspeeding and other forms of truck abuse."

Drivers Must Know the "Reasons Why." As the editor scanned this material, he was struck by the fact that most of it merely reiterated the statements in various forms, that "Overloading is bad, and so forth." It was for the most part a series of "don'ts," a succession of warnings, impressively put, it is true, but not backed up by the "reason why."

He approached the problem from a different angle. It is not enough, he perceived, to tell the driver that overloading is bad. Always the human mind asks *why*, and if it does not receive the answer—a sufficient answer—it is unsatisfied. And there are good and sufficient reasons why overloading and overspeeding will ruin the best truck or passenger car in the world. These reasons are sound because they are founded on mathematics—an exact science. The truck engineer knows them, as he plots the lines and curves of his blueprint, with the aid of his slide rule, his calculus, and his technical education. But while your *driver* knows, your superintendent knows, or perhaps even you yourself know, that "overloading is bad, overspeeding is bad," that is not enough.

How Truck Makers Helped. Accordingly, having received from the truck manufacturers the commission to educate the truck operator and driver, he went back again to those manufacturers and said, in effect: "This information is right in your own offices. There is never a time when your engineer designs an axle, or a spring, or a beam, or a bolt, that he does not figure on a certain stress and strain caused by the forces brought into play by speed, weight, and the surface of the road. What are these forces? How are they multiplied by overspeeding?

How by overloading? What is their effect? If we can in some way or other take these facts from off the tables of your engineers, strip them of their x^2 and their y^2 and their algebraic and technical trimmings and present them in bald and simple fashion, make the driver see what is happening to the axle or the frame or the transmission of the truck, he will, by virtue of that knowledge, have an understanding and almost a sympathy for the truck as a piece of machinery, that will more persuade him to take care of it than any number of warnings such as 'don't overload.'"

The results of this investigation are all contained in later chapters in this book. From them the employer may not only derive some helpful ideas himself as to the proper care and maintenance of his truck, but he will also find the keynote of the campaign for instructing his driver, and that is, "*Tell the Driver WHY.*" Make him understand, and he will the sooner obey. A few examples will show how this can be worked out with practical results.

Simplifying Drivers' Instructions. The average driver has a fairly good notion that overspeeding is destructive. But does he know that doubling the speed of the truck increases the violence of road shocks by four? Tell him that. It is a fact which sticks in his mind when he has forgotten the instructions, "don't overspeed." But go further than that. Perhaps the driver doesn't believe it. Bring out the fact that if one of two bullets is fired with twice the speed of the other, it will penetrate a target four times as deep. This is picturesque, and the driver will remember it as long as he lives. But go further still. Everybody knows that if an object, such as a chair, falls to the ground from a ninth story window, it will be shattered into bits. Yet when it strikes the ground it has only three times the speed of the same object dropped from the first story. What causes this destruction? Speed. Three times the speed, nine times the blow. After the driver learns these facts he is likely to have a better idea of what speed does than ever before. But he must be appealed to and reasoned with in language he understands.

Take the matter of lubrication. Most drivers have a fairly good notion that lubrication is desirable, if not necessary. But how many drivers know that even a polished piece of steel will show under the microscope a jagged outline? Oil is required to fill up these little depressions and prevent the jagged edges from engaging and tearing out. Tell the driver that when you instruct

him to lubricate. The "jagged edge of steel" will live in his mind when he has forgotten your order to "oil up."

With a view to bringing home to the driver in as simple a manner as possible the necessity for adhering to certain rules, a well-known manufacturer has drawn up a table of laws which are addressed directly to the truck driver. Business concerns have been quick to see the value of such a table of instructions and a great many copies of this code have been ordered and tacked up in conspicuous places in garages where they can be brought readily to the attention of truck drivers. It contains good advice which it may well profit you to bring to the attention of your truck superintendents or your drivers. It follows:

MR. TRUCK DRIVER:

You are your own Corner Cop.

Don't try racing with a touring car; your truck was built for strength, not speed.

Wash your truck frequently; a dirty-faced delivery car spoils a lot of your employer's printed advertising.

Don't neglect a squeak; noise is a protest against disuse of squirt can and grease gun.

Street car tracks are nice for springs but hard on tires—and steel costs less than rubber.

Don't keep extra spark plugs and other delicate parts in with wrenches and jacks; the hash they make isn't a good truck diet.

Don't neglect a loose part, even though it seems to operate more freely that way.

Don't take it in one load if it should be hauled in two; a single straw overload broke the well-known camel's back.

Letting her coast full tilt down this hill only means harder pulling to get her up the next one.

Don't forget to watch the fellow ahead; a quick stop on your part nearly always costs you a punctured radiator.

Use your brakes when getting "spotted"; platforms were built to load from, not for bumping posts.

Don't drive too close to the curb; edge trimming is a fine institution for pie crusts, but too expensive for truck tires.

The steering wheel is vastly important, but it is well also to give the grease cups an occasional turn.

Don't slide the rear wheels when stopping; rubber pavement polishers are too much of a luxury even for your boss.

Make haste slowly—especially when going around corners on a slippery pavement.

Don't let the motor "idle" while you're making a delivery; the radiator won't freeze during a reasonable stop.

Keeping the Driver Out of Court. One of the vexing problems in connection with the truck driver is that of keeping him out of court. The danger is always present that the driver, through recklessness or ignorance or failing to appreciate the well-established road laws of a city, will thus render the employer subject to a fine. Moreover, if such infraction of the laws be attended by an accident, the owner will have no redress and may be compelled to pay a sum much larger than a fine, namely damages. There are few truck owners who do not at some time take it upon themselves to lecture their drivers on this subject. But the knowledge of the employer is often deficient in this matter, and consequently the truck owner will do well to consider carefully the following table of dos and don'ts which was drawn up by a Chicago judge whose chief business was to listen to cases involving infraction of traffic laws and accidents. Make a copy of this table and post one where your driver can see it and give one to your truck superintendent or keep it yourself.

PLEASE DON'T	PLEASE DO
Don't permit your chauffeur to drink intoxicating liquor while operating an automobile.	Always drive on the right side of the street.
Don't drive faster than the law allows.	Pass all vehicles except street cars on the left.
Don't permit your exhaust to smoke.	Use best lamps and light them at sundown.
Don't cross a boulevard until you come to a full stop.	Procure your vehicle tax at once and save court costs.
Don't pass a street car on the left side.	Observe the traffic laws strictly.
Don't pass a street car while passengers are boarding it or being discharged.	Obey officers on crossings.
Don't keep your muffler open at any time or place.	Avoid arguments with officers, although you may think they are wrong.
Don't use glaring lights.	Use dim lights on front of car.
Don't keep up a conversation while driving.	Use tire chains on rainy days.
Don't drive on the wrong side of the street.	Signal drivers back of you in case you intend to turn or stop your car.
Don't drive on street car tracks.	Stop your car at all boulevard crossings.
Don't permit anyone under the age of eighteen years to operate your car.	Watch your speedometers and have them tested often.
Don't allow a driver to operate a car until absolutely competent.	Procure and study the city ordinances and the laws of the state pertaining to vehicles.
Don't permit your chauffeur to speed.	Stop ten feet back of a car while same is discharging or taking on passengers.
	Pay special attention to the laws pertaining to speeding.

Two Theories on Responsibility of Driver. In the matter of instructing the driver the perplexing question always arises: How far shall we go with him, and to what extent shall we hold him responsible for the proper care of the truck? This is a troublesome question and one that is not easily answered. It is obvious that the average driver who learns readily how to shift gears and manage the clutch often is totally unacquainted with the mechanism of the chassis and its proper maintenance. To what extent, therefore, shall the driver be made responsible, not only for the driving of the truck but also for its upkeep?

Putting it Up to the Driver. There are two schools of thought on this subject. The argument of one is put rather plausibly, as follows: The driver should be made responsible for the condition of his truck. If his job is merely to drive the truck during the day time and leave it at the garage at night, he will not realize how much he has abused it during the day, as it is the job of the mechanic to put it in order again for the next day's work. As a result he will tend to relax his care of the truck during the day. On the other hand, if he realizes that it is his job to keep the truck in shape from day to day and that, he is responsible for its condition all the time, he will appreciate as never before, the great importance of careful driving, attention to lubrication, and other details, while the truck is on the road and this will inevitably mean fewer repairs and adjustments after the truck reaches the garage at night.

Relieving the Driver. The belief of the second school, however, may be stated as follows: although maintenance is closely related to operation, it should not be confused with the latter which is limited to the care the driver gives the truck. For example, a locomotive is operated on fixed rails under the care of a high-salaried expert. Nevertheless it is inspected at the end of each trip under the supervision of the master mechanic, and it is sent to the roundhouse from twelve to fifteen times a year for a thorough overhauling, even if its peformance on the road is entirely satisfactory.

The responsibility of seeing that the truck is maintained at its proper efficiency should not rest on the driver. As a careful operator he, of course, should know when he starts out in the morning that a sufficient amount of lubricating oil is in the system, that water is in the radiator and circulatory system, that the brakes are properly adjusted, and that there are no loose

nuts or bolts. If a knock or squeak develops during his run he should report it. When he is driving the truck, however, his eyes should be on the road ahead of him, and his thoughts on his deliveries and sales. If he has to worry about the performance of his truck, it is going to be a somewhat thoughtless and aberrated driver that presents himself before his customers in many cases.

The Truck Owner Must Decide. Confronted by these two conflicting opinions, the business man must look to the needs of his own business for the decision. On the one hand, it is well to instill a feeling of responsibility in the truck driver; on the other hand, one must recognize that the average driver is not equipped, is not paid for, and should not be expected to handle the fine mechanical work involved in overhauling and maintaining the expensive mechanism of the motor truck. The question is likely to be decided finally by the size or number of trucks which a concern operates. If the fleet consists of ten or more trucks it is obvious that the advantages gained by hiring one or two expert mechanics is greater than may be derived by making each driver responsible for the condition of his truck. On the other hand, if the business man operates only one or two trucks, he cannot afford to hire a mechanic, but must rely upon the services of the driver to keep his trucks in shape. That being the case, he should realize at the start that he must hire drivers who have more than ordinary mechanical skill and he must not make the mistake of refusing to pay them the additional salary which such skill should command. He must, furthermore, post himself or some other intelligent person in his employ on those matters regarding truck maintenance which are to be found rather in books than in the average practice of the profession. Thus, for instance, most truck manufacturers publish instruction books in regard to the operation and care of their trucks. These books are literally filled with information, all of which is pertinent to the care of the motor truck. It is hard to imagine the oil-stained driver-mechanic turning the pages of such a book, filled as it is, with fine charts and drawings of great detail. The owner must master such instructions, and having mastered them, he will find that he is well equipped not only to oversee what is going on in the garage, but to give to the driver or mechanic suggestions of which he may never have thought. (Figure 176.)

Seven Simple Rules. In instructing the driver, the owner is obliged to rely to a great extent on simple rules. An extensive

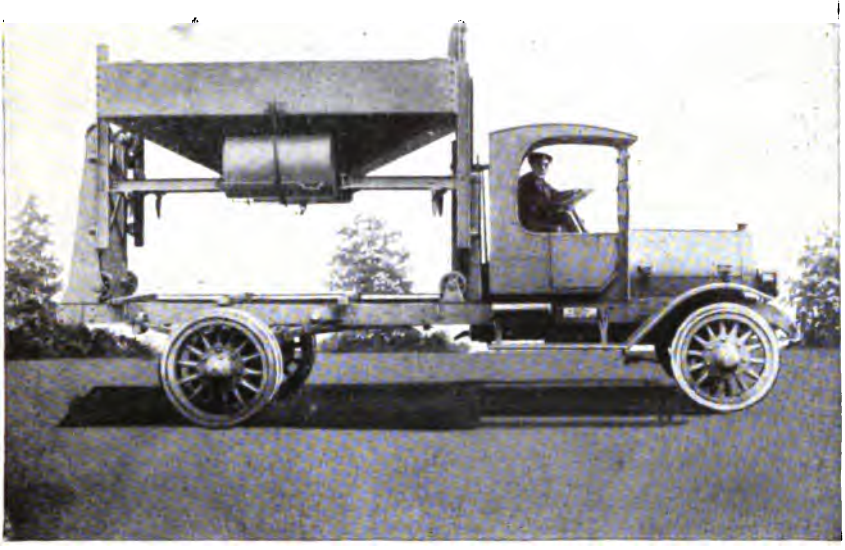


FIGURE 170: The body of this truck, elevated at this height, can deliver coal by gravity a distance of 30 or 40 feet. This plan is particularly useful where wide sidewalks, lawns, or embankments intervene between the truck and the coal hole.

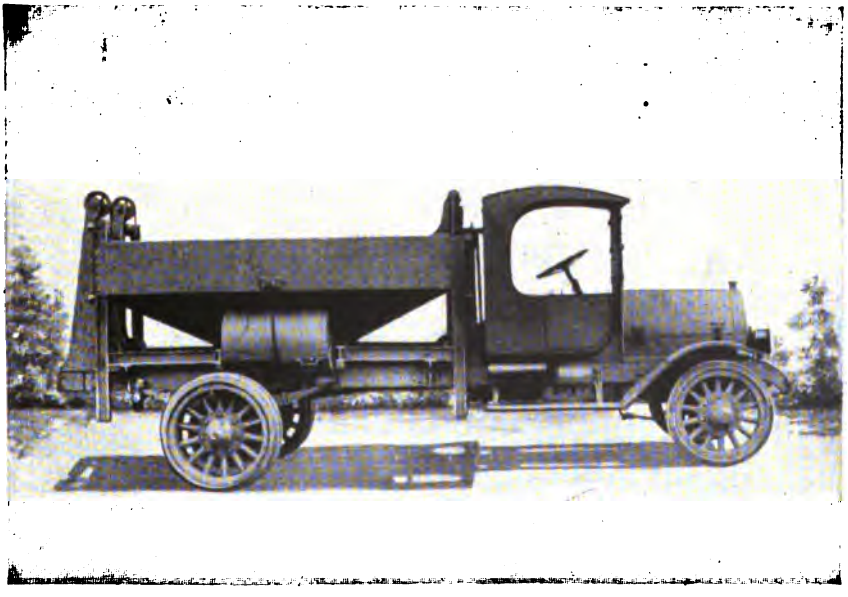


FIGURE 171: In this illustration the special dump body is shown in its normal loading position. It is the same truck as shown in the upper figure. Similar types are shown in Figures 148, 149, and 150. In each a hydraulic hoist furnishes the power.

FIGURE 172: It's good business to protect the driver in cold weather—it makes him more efficient, and more likely to take care of your investment. This closed cab protects the driver, is inexpensive and undoubtedly brings good returns.

FIGURE 173: It is comparatively easy to load this heavy lathe on the truck when the engine's power is applied through a winch. Not only is the winch a labor saver, but it greatly reduces the chance for accidents.

FIGURE 174: Grade and surface have an enormous influence on hauling problems. Railroad tracks are generally level, and a truck of this type is able under favorable conditions to act as a switch engine, hauling three to six cars.

FIGURE 175: The truck carries the material and the trailer hauls the tools and equipment which are needed. Many cities are saving money by using motor trucks, and in this economy trailers are playing an important part.

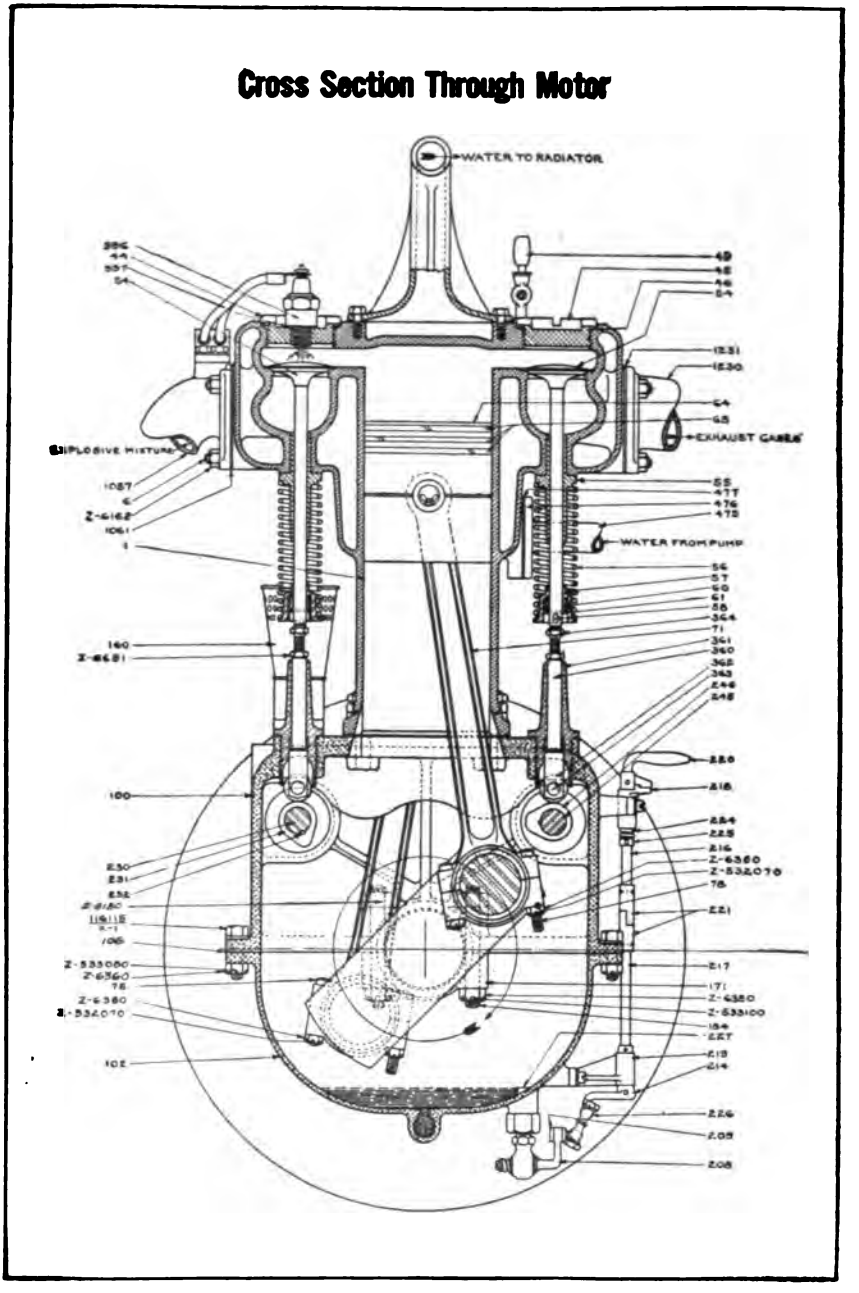


FIGURE 176: There are some instructions and explanations the driver could not reasonably be expected to understand—such, for instance, as this chart, issued by a truck manufacturer. The owner, however, can master such details, and explain them to his driver. Most truck manufacturers issue similar charts.

truck owner in a western city has had printed a series of rules on cardboard, and has placed these cards beside the driver's seat on every vehicle that he owns. These rules are simple and may be used whether you operate a fleet of trucks or one.

1. "In starting, follow a line parallel to the curb on the right-hand side. Don't swing out in the middle of the street.

2. "Keep to the right. In coming to a division in the road, choose right-hand drive.

3. "In meeting a vehicle, turn out to the right and allow it to pass.

4. "In passing a vehicle, go around it on the left and then return to the right side of the road.

5. "At signal from vehicle behind that it wishes to pass, keep close to the right edge of road, giving plenty of room.

6. "Slow up and sound horn at crossing or other places where view is at all obscured.

7. "In turning off on an intersecting street, make a sharp turn if going to the right; if to the left, a wide turn, rounding the central point in the intersection of the two streets."

Interesting the Driver. How close does the average business man get to his driver? Inasmuch as the latter controls, to a large extent, the success or failure of the expensive installation, it behooves the truck owner to make friends with his driver and secure his confidence. The driver is human and one of his strongest human traits is the interest which he shows in his truck. This interest can be fostered or not as the employer chooses. If he decides to encourage it, let him try for the moment to get the driver's point of view. The chauffeur is distinguished from many another laborer in that he has in charge a fine and expensive piece of machinery. It is natural for him to take a pride in his car because of that fact. He likes to see it shine, he likes to be able to say "She's working like a watch," he likes to make it work efficiently. Stop the driver on the road on some trivial pretext, and nine cases out of ten he will plainly show impatience to start on.

Welfare Work for Drivers. Pride is a feeling to appeal to. This can be done best when the owner shows a genuine interest in the driver. Take the following instance: During cold weather, drivers of either teams or motor trucks are frequently exposed to storm and cold for several hours at a time until they become chilled through. This is, in many instances, used by them as an excuse for "stopping in at Charlie's on the corner to get a drop to warm them up a bit." Many times the hard, cold

surroundings of the men during waiting time or the luncheon period are really conducive to leading them to the saloon. That this does not promote better service from the men is well known.

One manager, who takes a real interest in the welfare of his men, introduced the plan of furnishing a stove, coffee pot and coffee to his men through the cold winter months. This cost but a small amount per week, but he felt that the results—better conditions and cooperation of his men—more than repaid him for the expense incurred. So well was the manager pleased that later free soup and bread were added.

May not this plan, if made more universal, result in better services out of your truck or teams through winter months?

Fair Treatment Pays. The methods of getting the driver's interest are many, but two which stand out above the others are so important that each will be treated in a separate chapter. The first way is by treating the driver squarely. Perhaps this can best be accomplished by equipping his truck with a mechanical recorder which will give him credit for the work he does, and at the same time protect him against blame for delays for which he is not responsible. The recorder is to the fleet of trucks what discipline is to the army, and drivers who work with trucks equipped with recorders know there is less chance for them to be treated unfairly, not only with respect to their employer but also to their fellow drivers.

The other method is the installation of a bonus system, and it may be said that such a system in one form or another promises to be almost the salvation of the truck driver problem. How it is planned and how it has increased the profits of many well-known business houses which have adopted it is told in Chapter XVI.

CHAPTER XV

SUPERVISING YOUR TRUCK BY MECHANICAL DEVICES

WHAT happens when the truck goes out on the road? This is the problem which stares every traffic manager in the face. But one does not have to be a traffic manager of a fleet of trucks in order to be concerned in this problem. The owner of one truck is as close to this difficulty as the owner or superintendent of several.

What happens when the truck turns the corner and disappears on its morning trip? "Nobody knows except the driver, and he won't tell," to paraphrase a slang expression. The owner or the fleet superintendent may dispatch a truck or a fleet of trucks with a smiling face and turn back to his desk with an expression of unconcern, but he is concerned nevertheless, although he may not show it, for ever since the truck disappeared from view down the street the man at the desk who is responsible finally for its efficient operation cannot be certain whether that motor truck or his whole fleet is being operated efficiently or not.

There is something unique about the position of the truck driver. Unlike the workman in the shop or the clerk in the office, the truck driver does nine-tenths of his work away from the supervision of his employer. As we have shown in the previous chapter, he is to a large extent free from supervision which business men have found it necessary to maintain wherever possible over their employees. When the driver is out of sight who knows whether he is keeping his truck busy or not? He is only human like the rest of us, and is often sorely tempted. Moreover, it is almost impossible to keep track of him.

Devices that Check Performance. Mechanical ingenuity comes to the aid of the truck owner in this difficulty, and shows him a way by which he can keep a record of the movements of his truck almost as well as he could by sitting on the seat beside

the driver. Devices have been perfected which can be attached to the truck and which make a record of the day's performance in minute detail. From this record, which appears on a chart, the owner can tell the time when the truck started out, when it stopped, how long it stopped, in each case, the length of trips, the time taken in loading and unloading, and so forth. This data, which is as complete as could be desired, and which takes precedence in its truthfulness over any human testimony, gives the traffic manager at the end of each day the very facts which previously he had no means of knowing.

Let us consider an example of the many ways the data can be used to save wasted minutes that mean dollars. A concern in a western city, doubtful as to the efficiency of its fleet of delivery trucks, installed recording devices on each vehicle. The delivery superintendent at first concerned himself only with the longer stops shown on the daily charts of each truck, and every morning, in glancing through the charts of the day previous, would lay out for his attention only those charts that looked a little unusual in one way or another. One day he laid aside two charts that each showed stops of about an hour and a half. On second glance he saw that the stops were at the same time of day. Then he realized the trucks worked on adjoining routes and that the drivers were undoubtedly together at that particular time.

Calling the Turn on Unnecessary Stops. Knowing the men and their routes pretty well he was able to say with quite a display of assurance the next time one of them came in, "You and Mack stayed an hour and a half at O'Brien's yesterday afternoon. If you can't shorten up a whole lot of that 'Kelly pool' stuff, you are going to get time out after this." That the delivery superintendent had hit the nail on the head was evident from Joe's reply, "An hour and a half, you say; we weren't there much over fifteen minutes. Let me see those charts." He was shown the charts, admitted they might have stayed longer than he at first thought and agreed to watch his time more closely thereafter. The delivery superintendent was able positively to know that they both corrected this abuse.

The American business man is accustomed to value his time in terms of money. He now has a rival, for not only is the time of the motor truck worth money, but it may be worth several dollars an hour. If it costs an average of $16 per day to operate a 5-ton truck, the time of that truck is worth at least

$2 per hour, but if it is figured that the truck which costs $16 is bringing in $40 a day, then it is proper to say that for every hour that the truck stands idle, the owner is suffering an absolute money loss of one-eighth of that amount, or $5. In fact, there are not very many business men whose time is worth more than the time of a 5-ton motor truck. A good executive looks with concern upon anything that wastes five or ten minutes of his time, but he often does not take the trouble to investigate whether the time of his motor truck is being wasted, or perhaps the time of every one of his fleet of trucks, which in aggregate loss may amount to a figure exceeding his own salary.

How the Time Recorder Works. The actual working of such a time recorder for trucks will be made clearer by the chart shown in Figure 177.

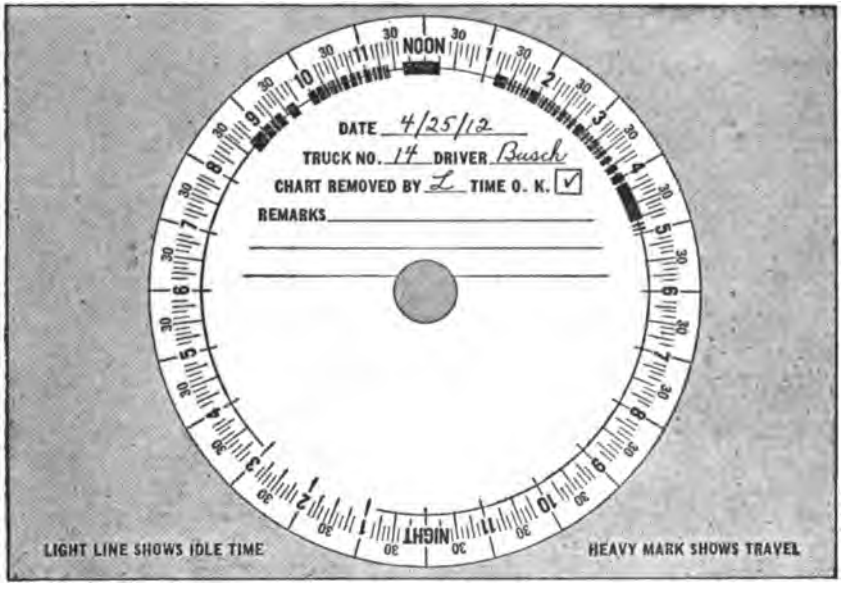


FIGURE 177: When did your truck leave the garage—report for work—how long to load it—how long to make the trip to the suburbs—what stops on the way—stop for lunch—for loading—when turned in? The recorder tells the story.

This chart shows a day's work by a truck belonging to an express company engaged in collecting packages in a residential district. The chart was inserted at 3 a. m. by the night man at the garage. The truck would ordinarily have left the garage at 7 a. m., but was held up because of a delay in receiving instruc-

tions from the main office. At 8:40, however, the route sheet was received and the driver started. His first run was for 20 minutes, from the garage to that part of the city in which he was to pick up packages. At 11:40 he started back to the main office, where he arrived at 12:15. The afternoon trip began at 1:15 and lasted until 4:45, when the vehicle arrived at the garage. The chart shows two short moves of the vehicle between 4:50 p. m. and 5 p. m. (in this case the truck was being placed for the night).

From the chart and the trip sheet it is evident that, after it got started, the truck had an unusually efficient day. The driver had only four stops of over five minutes in the morning, and one in the afternoon. But the truck stood idle for nearly an hour and forty minutes in the morning, before it got away from the garage. This time is excessive, and at $1 an hour (the approximate cost of the service), this loss demands an improvement of conditions in the dispatching department.

Thouands of Dollars Saved! The experience of a New York wholesaler is illuminating as showing how the use of such an instrument has reduced the small leaks which, considered in the aggregate, used to cost him thousands of dollars a year.

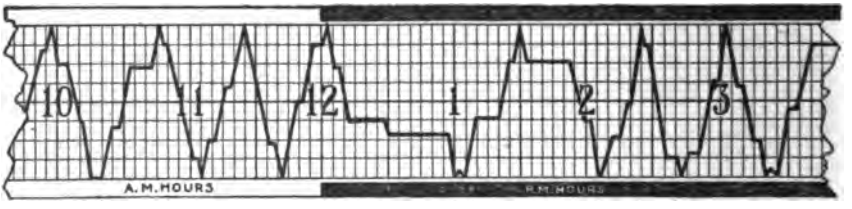


FIGURE 178: This chart will, when used a with recording device, tell the truck owner four major facts: (1) when the truck started and stopped; (2) how fast it traveled; (3) how many miles it covered; (4) when and how long it lay idle.

It was the practice of this concern to permit certain trucks to proceed directly from the garage in the morning to the freight station to pick up incoming freight, instead of requiring them to report first at the store. This, of course, allowed a certain leeway to the truck driver inasmuch as it removed the check which the main store might otherwise have kept by requiring the drivers to report with their trucks at a specified time at the beginning of each work period.

If the truck arrived late at the store the driver reported that he was "hung up" at the freight stations, as undoubtedly he

frequently was. The machine was housed at night in a horse barn, presided over by a barn man. A time recorder was put on the truck. The charts started right in to make some interesting disclosures. The recorder said the truck didn't get away from the barn until 8 o'clock, 8:10, sometimes 8:20, and the barn boss, when telephoned about this, said the truck ran out promptly at 7:30 every morning (the proper time for starting) and that the "fool gimcrack" on the truck was "off its base." To make a long story short, the barn boss and the new truck driver had connived to stop the wheels of progress and discredit the mysterious supervisor by pitting their "stories" against the mechanically accurate records. The obvious happened and an expensive leak which had been running for months, was located and plugged up for all time.

Time Recorders Real Aids to Drivers. By far the most interesting fact in connection with mechanical supervision is the effect which it has in getting the drivers to take a real interest in keeping the trucks at work. Once they realize that their movements are known by the traffic superintendent, almost as accurately as if he had been with them, and furthermore, that every unusual delay would come before his attention and require a special explanation, the drivers see to it that any case of delay is reported. Thus in the case mentioned above, if the truck is liable to be held up for an hour or two the driver at once communicates with the traffic superintendent giving him full particulars with regard to the nature of the trouble that he has met with. These lay-ups must have occurred from time to time before the recording devices were installed; nevertheless this firm reports that previous to this it was a rare thing indeed for a truck driver to call up during the day on account of delays.

Such devices, however, are not so much detectives as they are aids to the truck driver. Let me give you one instance. A packing company in Chicago operated a truck which was supposed to deliver meat every morning at 9 o'clock to a certain store. The storekeeper, however, complained that the truck was often late. The recorder on this truck showed that there was often a wait of about one-half hour, which occurred near 9 a. m. As this needed explanation, the proprietor examined further. He found that owing to the crowded condition of the alley leading to the store platform, it was often fifteen or twenty minutes before the driver could deliver his goods. The packing

company and the storekeeper got together at once and corrected this condition. The recording device exonerated the driver, who had been under suspicion.

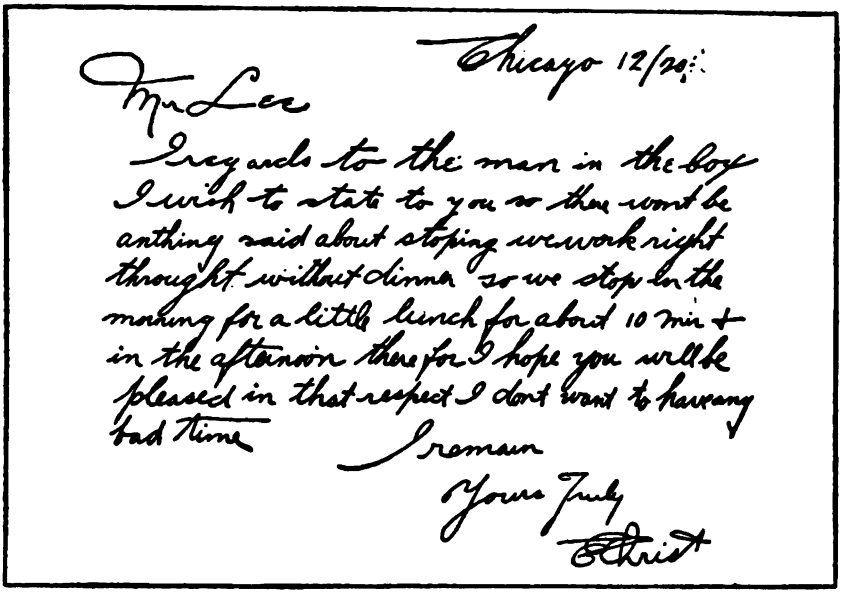
Increasing the Running Time. A telephone company in a mid-western city kept close record for some time, by usual means, of the actual running time of their trucks compared to the total time that they were out. At the time of which I speak this actual running time was 28% of the total. The company installed a recorder on its machines and did nothing whatever at first to improve conditions, only explaining to the drivers the mechanical construction of the device. A few weeks later they found that their actual running time had risen from 28% to 33% without any effort from superiors to correct faulty conditions.

A striking example of the manner in which such a recording device protects the business man against unfair charges is afforded by the experience of a Cleveland store. One of its trucks placed at night in a public garage was found the next morning to have a broken spring. It was at first supposed that the spring was broken toward the close of the previous day and had not been noticed by the driver when he put the truck up for the night.

Recorders as a Protection to Drivers. The driver stoutly maintained that the truck was all right when he put it up at night and asked for an examination of the recorder chart. By the way, in this instance the recorder was installed high up under the top of the body in the back of the truck where one would not usually expect to see it. The chart showed a travel of about a half hour at midnight of the night before. The night man in the garage had used the truck to "tow in a cripple." If he had known about the recorder and that the trip was going to show up in such fashion, he would surely have picked some other car to use. Needless to say, the recorder saved the truck owner from paying for the broken spring. Instead of being without the use of a truck for a day or two and having a good sized repair bill besides, they were loaned a truck by the garage man and collected a little for damages. The evidence of the recorder was superior to that of any human witness testimony.

As a concrete evidence of the fact that truck drivers gain a new sense of the value of time once they realize that the recorder keeps a record of every stop and every minute of idle or standing time throughout the day, the note shown in Figure 179 was received by the truck superintendent of a Chicago manufacturing

concern, and turned over by him to the manufacturer of the device to whose courtesy we are indebted for permission to reproduce it here. That this is a "human document" indeed,


Chicago 12/29

Mr Lee

Regards to the man in the box I wish to state to you so there wont be anthing said about stoping we work right throught without dinna so we stop in the morning for a little lunch for about 10 min + in the afternoon there for I hope you will be pleased in that respect I dont want to have any bad time

Yours Truly

FIGURE 179: This letter shows how one driver responded to the influence of a recording device. He knew that his truck had been idle, and that it would show on the chart, so he hastened to absolve himself of responsibility.

will scarcely be denied. The driver had a legitimate excuse for the two delays which he knew would show up on the chart, and he resolved to present that excuse beforehand rather than wait until he should be asked for an explanation.

Diagnosing Delays. A remarkable instance of the way in which a recording instrument of this kind enabled a concern to detect five different causes for delay is reported by a large coal company doing business in Georgia.

It should be realized at the outset that it is not enough for a truck operator to know that "delay has occurred" in the operation of a given truck. This is rather common knowledge with most truck operators and does not help the owner particularly in removing the cause of the delay, since delays may occur at various places between the home plant and the delivery point, and may be due to various causes, some defensible and some not. What is needed is an "all-seeing eye" as it were, that

shall witness all delays, and a mechanical finger that shall record them faithfully on a chart, and with due regard to their order and their duration in the course of each trip. Knowing these facts, the business man can find faults, and correct them, in nearly every delivery system under the sun.

This coal company equipped its vehicles with recorders, and in a short time was in possession of some startling information, as disclosed by the chart shown in Figure 180. A brief study of the sections of this chart will repay the owner who would learn how another truck operator ran down a series of delays, each one chargeable to a different cause, and which taken all together represented a loss of running efficiency of 43%.

Beginning at the left of the fragment of the chart, the dark portions show a steady running time of fifteen minutes, which the operator knows from his route sheet, indicates the return of the truck to the yard from its first trip of the day. The truck reached the yard at 8 o'clock. There it stopped and did not move for twenty minutes. Here was a startling delay at the outset. What was the explanation?

Placing the Responsibility. The matter was investigated and the driver complained that the yardmaster had issued no order to him for the full twenty minutes that the truck had remained idle. This brought the investigation up to the yardmaster. The yardmaster admitted that he might have been a little lax in handing the order to the driver, but he contended that he was only partially responsible for the delay, since he had held the order for only five minutes while attending to other matters, whereas it was fully fifteen minutes after the truck had come into the yard before the order had been issued. The investigation proceeded to the order department, where it was found that, partly due to a faulty system, and partly due to an inefficient clerk, orders were issued in a haphazard manner, and without regard to the time schedule of the motor trucks themselves. This was remedied, arrangement was made whereby a copy of the schedule of truck movements was kept before the order department, the yardmaster was cautioned, and thus, after filling up many holes, this particular leak was closed up. But this was only delay number 1.

The recorder now pointed to another of a different kind. After the driver had finally received his order, the chart shows that the truck traveled for about five minutes. This indicated

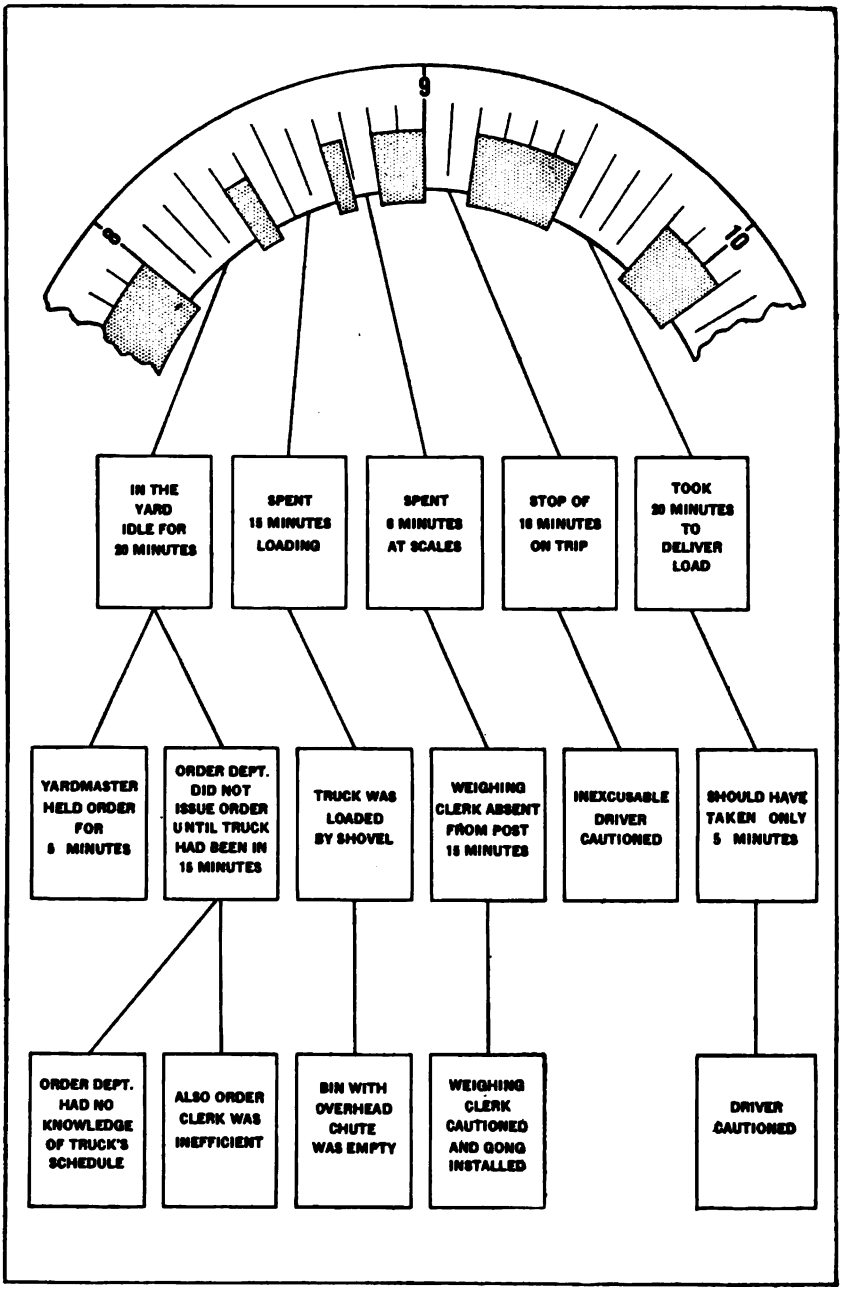

9
8
10
IN THE YARD IDLE FOR 20 MINUTES
SPENT 15 MINUTES LOADING
SPENT 6 MINUTES AT SCALES
STOP OF 15 MINUTES ON TRIP
TOOK 20 MINUTES TO DELIVER LOAD
YARDMASTER HELD ORDER FOR 5 MINUTES
ORDER DEPT. DID NOT ISSUE ORDER UNTIL TRUCK HAD BEEN IN 15 MINUTES
TRUCK WAS LOADED BY SHOVEL
WEIGHING CLERK ABSENT FROM POST 15 MINUTES
INEXCUSABLE DRIVER CAUTIONED
SHOULD HAVE TAKEN ONLY 5 MINUTES
ORDER DEPT. HAD NO KNOWLEDGE OF TRUCK'S SCHEDULE
ALSO ORDER CLERK WAS INEFFICIENT
BIN WITH OVERHEAD CHUTE WAS EMPTY
WEIGHING CLERK CAUTIONED AND GONG INSTALLED
DRIVER CAUTIONED

FIGURE 180: This simple chart, taken from a recording device installed by a Georgia coal dealer, disclosed five different delays in one trip of his motor truck. An investigation revealed inefficiency in nearly every department of the business. The sources of delay were removed and the tonnage hauled increased 43%.

FIGURE 181: Note the all-metal construction of this 5-ton dump truck used in contractor's service. Trucks operated under severe conditions have shown that the fewer wooden parts they have, the better they will withstand usage.

FIGURE 182: The scarcity of seasoned timbers for wooden wheels has made the wheel manufacturer turn to metal. This 5-ton dump truck uses steel wheels having hollow spokes and rims, thus combining lightness and strength.

FIGURE 183: This type of demountable body is equipped with wheels to travel on platform rails. It is moved by hand until a pinion operated by a hand crank engages a rack on the bottom of the body and completes the operation.

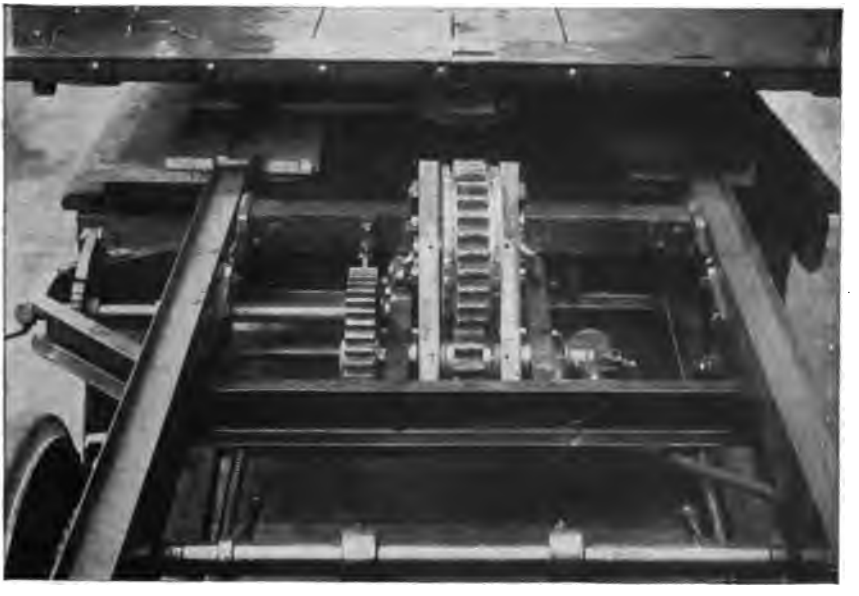


FIGURE 184: This "close-up" gives a clear idea of the mechanism used on the demountable body shown above. When loading platforms are equipped to handle them, heavily loaded bodies may be moved with ease.

FIGURE 185: The Fifth Avenue Bus line is as well known in New York as the Elevated, and is patronized by thousands, who find it worth while to pay a 10-cent fare and enjoy the superior accommodations of this transportation service.

FIGURE 186: Note how this industrial truck with its twenty-five crates is headed straight into the freight car. Even in the limited space inside the car, it is easily maneuvered and in a few minutes is on its way again for another load.

that the truck proceeded to a loading point for the certain kind of coal called for in the order. But having arrived at the loading point there occurred an unexpected delay of nearly 15 minutes. This was inexcusable, inasmuch as the yard was equipped with large overhead bins which delivered a load of coal through a chute in less than thirty seconds. Investigation showed that the bin having the kind of coal called for had been allowed to run empty, and therefore it had become necessary to fill the truck by shovel from a pile. Steps were taken to prevent the recurrence of this, and delay number 2 was checked.

But there are different kinds of delays, and each one will tell its own story, if it is only properly pointed out. The chart now shows a running time of four minutes sufficient to take the truck to the scales for weighing. And then delay number 3 occurred—six minutes on the scales.

Speeding Up Weighing Operations. It should not take six minutes to weigh a load of coal—not even a truckload. Hence the investigation led to the door of the weighing clerk. It was found that he had been absent from his post. As his duties were more or less intermittent, he had been in the habit of leaving his post for as long as ten minutes at a time. Moreover, he was unused to the ways of the motor truck, because previously the coal company had used horses. He was advised as to the value of the time of a motor truck, and, as an additional precaution, a gong was fixed on the scales shed by which the driver could summon the weigher if, in the future, he should be absent. Delay number 3 was run to earth.

The chart now showed a running time of ten minutes without a pause. Then occurred a short break, where the truck had stopped for ten minutes. The owner knew that this was not due to the truck's delivering a load, inasmuch as the driver had only one order, and the delivery point could not possibly have been reached in less than thirty minutes. The driver admitted he had stopped to talk with a friend. Delay number 4 was fully explained.

The chart next indicated that after this stop the truck proceeded on its way without pausing, and the next stop did not take place until the load was actually delivered. Here, however, occurred a delay of fifteen minutes, whereas it should not have taken more than five minutes to deliver the coal, as the truck was provided with a dump body and chute attachment. The

driver, questioned, promised to make a better showing thereafter. Delay number 5 was discovered and corrected.

Time Recorder Almost Doubles Tonnage. Now had the truck owner merely "felt that delays were occurring" in the operation of his trucks, he could have made only a general complaint. As it was, however, a mechanical recorder whose testimony could not be questioned, informed him not only how much of the time his truck was standing idle, but the duration of each separate delay, and when it occurred in the course of each trip. Armed with this specific information, he was able to corner each delay and arrive at a solution which was in each case fair, square, and scientifically accurate. As a result of this system, he increased the tonnage hauled approximately 43% with the same rolling equipment.

The details of many other successful installations could be described here, but the underlying principles are the same in all.

Recording Devices Becoming Popular. In view of these advantages, which may be considered as typical, and subject to application upon any particular installation, it may be asked why these devices are not more generally used. In the first place, it must be admitted that their initial cost is comparatively high, and that the average owner considers them unnecessary, since he feels competent to analyze and direct the performance of his truck without the aid of this mechanical refinement. On the other hand, many truck owners who have installed them assert they have more than paid for themselves in a short time by disclosing leaks which otherwise would have been difficult if not impossible to detect.

Next, it is contended that the mechanism of such devices is so delicate that it cannot withstand the severe jolts and jars it must inevitably receive in service. Improvements are constantly being made, however, and the best recorders obtainable today are far more substantial and durable than the earlier types. Moreover, the makers of these instruments generally prefer to sell not the machine only, but the service of supervising their installation and maintenance, which carries with it expert interpretation of the charts and advice and counsel coming from intimate contact with the problems these devices are designed to eliminate. This aspect of their value is most interesting and worthy of consideration from the intelligent and progressive manager.

CHAPTER XVI

INSTALLING A BONUS SYSTEM

AT first thought the idea of a bonus or reward for the truck driver is apt to be distasteful to the average American employer. It savors too much of a tip. The driver is hired to do good work—not bad, and his wages should be sufficient to compensate him.

Such sentiments are creditable, but not especially sound. The truck owner should realize from the start that the position of the driver is unique. We must recognize the fundamental fact that the driver is doing nine-tenths of his work outside of the supervision of the employer. He is, moreover, engaged in work which is admittedly difficult, and which calls for the exercise of vigilance, judgment, and restraint; qualities which the average worker does not pour into his labor for day's wages. Lastly, the driver, working under these conditions, controls the destiny of an investment worth from one to six thousand dollars. The very life of the investment depends entirely upon the care and effort of the man in charge. No business man would think of putting such a responsibility on the driver of the truck if there were any way of avoiding it.

Analyzing the Reasons for a Driver's Bonus. A little effort is required, perhaps, to get a correct vision of this matter, but the effort is worth while. Let us suppose, for instance, that an inefficient driver shortens the life of a truck by two years. This may very conceivably cause a loss to the owner of $1,000.

It is not easy for the average man to appreciate this possibility, and to assign to it, somewhere in the dim future, its actual value in dollars and cents. Yet we know that every day trucks are being discarded which, with good care, interested care, might have lasted not two, but three or four years longer.

Consider not only the life of the truck, but the cost of repairs during its use, which might have been prevented by proper

driver's care. The owner who might object to paying a bonus of a dollar or two a week, will pay without hesitation a bill of fifty, one hundred or two hundred dollars for broken parts, because there is no escape from it. Besides this, add such considerations as accidents, litigation, cost of tires and fuel, and the amount of work done daily, and you will see that the truck owner is in an excellent position to play a little game with the driver, in which he has nothing to lose and a great deal to gain.

The following are six specific methods of installing bonus systems for drivers, which have been fully tested by six different concerns and have in each case succeeded in their object, which was to get better service from truck drivers and to lessen the cost of truck operation, even after paying a substantial bonus.

The Basis of a Tested System. A prominent builders' supply company, of Philadelphia, has inaugurated a system of rewarding its drivers which is unique. The result of this system is to reward two things: first, the activity of the driver, that is, the miles of useful work which he has covered in the time at his disposal; and second, his economy in using oil and gasoline in performing that work. The two results are expressed in percentages, and the two percentages are "mixed," so to speak, giving a single resultant percentage which expresses the driver's efficiency in both work accomplished, and fuel consumed.

This concern arrived at its percentage by taking as a basis six minutes, which is the amount of time a truck is supposed to require to cover each mile while in active operation. This is multiplied by the actual number of miles covered per day and divided by the number of minutes operated minus the number of trips multiplied by 10. The figure 10 represents the number of minutes allowed for both loading and unloading and when multiplied by the number of trips gives the total legitimate standing time for the day. This is expressed in the following formula:

$$\frac{\text{6 minutes} \times \text{the number of actual miles traveled}}{\text{Total minutes minus (number of trips} \times \text{10 minutes)}} = \text{Percentage of actual time required with reference to the ideal time.}$$

The result of this formula is to give what might be termed the activity of the driver; that is to say, having a certain amount of mileage to cover, he kept his truck so busy by eliminating idle time, that the actual time which he required to accomplish his day's work was only 10% or 15% longer than the ideal time. In other words, the driver is 90% or 85% efficient.

This, however, is only half of the complete formula. It will be noticed that this statement checks only the activity of the driver. It is possible that a driver, in his anxiety to show good running time, might waste his gasoline. For instance, he might leave his engine running while making a delivery in order that he might save a minute or two in starting up again. As a counter check, therefore, this concern has devised a second formula which works in connection with the first. They have discovered that their trucks should run about five miles per gallon of gasoline. With this as a starting point, they have devised the following formula which will assist materially in establishing a working basis:

$$\frac{\text{Number of miles actually run}}{5 \text{ miles} \times \text{the number of gallons actually used}} = \text{Percentage of efficiency in using gasoline}$$

Let us suppose, for instance, that the truck covers 60 miles in a day, but uses 14 gallons in doing it. The result is as follows:

$$\frac{60 \text{ miles}}{5 \times 14} = 85\%$$

He should have made 70 miles with 14 gallons of gasoline, but as a matter of fact, he was only able to cover 60. The driver is therefore considered to be 85% efficient in this respect.

Both of these formulas give the answer in terms of percentage. The first formula gives a percentage which shows the *activity* of the driver; and the second formula gives a percentage which indicates whether or not he is *economical* in the use of fuel. By adding these two percentages and dividing by two, a "mixed" percentage is obtained which indicates the general efficiency of the driver both in *activity* and in *economy* of fuel. The two formulas when combined in one may be expressed as follows:

$$\tfrac{1}{2}\left\{\frac{\text{6 minutes} \times \text{number of miles traveled}}{\text{Total minutes minus (number of trips} \times 10)}\right\} + \left\{\frac{\text{miles traveled}}{\text{5 miles} \times \text{number of gallons gasoline consumed}}\right\} = \text{Driver's efficiency in work performed and fuel used}$$

In order to assist them in tabulating the data necessary for working out this formula, this concern has devised the forms shown in Figure 187.

Before a driver can collect a bonus, he must show at least 80% efficiency. Between 80% and 90% the driver receives a premium of $2 per week; between 90% and 100% an additional dollar, and for 100% he receives $4.

We were advised some time ago by this concern that they had increased their fleet to nine trucks, and were using the same amount of gasoline as they formerly used for five trucks before they had installed this system. They claim that this is due to the percentage system, which is an incentive to the driver to get as much out of the trucks as possible. It avoids long delays between trips, and when the truck is not running, the driver takes care to stop his engine and save the gasoline.

How a Chicago Concern Rewards Its Drivers. A bonus system on a different plan was worked out by Sulzberger Sons, now Wilson & Co., of Chicago. This system takes into consideration three distinct items of expense over which the driver is believed to have considerable control. These items are:

(1) Tires; (2) Mechanical Repairs; (3) Fuel.

Taking the item of solid tires, which, by most tire companies are guaranteed for 7,000 miles, the driver is given one-third of the saving made by reason of mileage received in excess of the guarantee. With regard to repairs, a first prize of $15 and a second prize of $10 are offered to the drivers who have the lowest and next to the lowest expense for repairs at the expiration of 5,000 miles. In this connection tonnage hauled and general condition of the truck are taken into consideration.

With reference to fuel, a prize of $3 per month is awarded to the driver having the lowest consumption of gasoline per mile, all things such as tonnage, mileage and condition of machine being considered. For the benefit of those who wish to try out this bonus system, full details are given in the following instructions, which were printed by the concern in question and entitled:

NOTICE TO CHAUFFEURS

It is our desire to bring about a condition, whereby good efficiency will be obtained from our gasoline motor trucks, and it is also our desire that the drivers be rewarded for cooperating with us in promoting this condition.

The tires are guaranteed for 7,000 miles. We propose to give each chauffeur 33⅓% of the saving he makes on tires, which run over this guarantee. If a tire, or full set of tires, run 6,000 miles over the guarantee, and estimating that four tires cost $140, this would be 2 cents a mile on the basis of the 7,000-mile guarantee.

On one tire it will be prorated on the above basis. One-third (⅓) of the amount saved will go to the driver.

$15 and $10 to be given to the drivers who have the lowest and next to the lowest, respectively, repairs on their machines at the expiration of 5,000 miles run—mileage, tonnage, condition of the engine in regard to efficiency, cleanliness, and so forth to be considered.

Any driver being absent from duty for more than one week, when truck is in service, will, at the option of this department, forfeit all rights to participate in any of the bonuses, sickness excepted.

When drivers resign by request or otherwise, all accumulated bonuses on that truck are forfeited to this department.

A bonus of $3 per month will be given to the driver having the lowest consumption of gasoline per mile, all things such as tonnage, mileage, and condition of machine considered.

The drivers are to make absolutely no adjustment on carbureters, magnetos, and so forth. We have expert repair men for this kind of work.

What Tire Mileage Indicates. Several bonus systems take as their basis the mileage received from the truck tires.

WEEKLY TRUCK RECORD

TRUCK NUMBER _____

DRIVER _____ WEEK ENDING SATURDAY _____ 19____

	MILES	GAS	MINUTES	TRIPS	OIL	TONS	WEATHER	REMARKS
SUNDAY								
TOTAL								
PERCENTAGE ——— × ——— = ——— × ——— =								

NOTICE TO DRIVERS

The minutes referred to are taken from time of starting in the morning to time of completing day's work, allowance being made for dinner hour and any time lost through not having work for truck or through repairs made in the shop.

Do not fill gasoline tank on Saturday after finishing work.

TIRES

	MAKE	SERIAL NUMBER	MILEAGE COMPLETED	MILEAGE DUE	CHANGES		REPORTED
					DATE	MILEAGE	
FRONT LEFT							
FRONT RIGHT							
REAR LEFT							
REAR RIGHT							

FIGURE 187: The superintendent of a big fleet of motor trucks uses this form in determining the efficiency of his drivers. It allows for a recapitulation of the formulas shown on pages 254 and 255 and forms the foundation of his bonus system.

While, of course, the driver cannot influence a great many things in connection with the upkeep of the truck, there is almost no kind of abuse that he cannot check. If he overloads or overspeeds the truck, or drives it in rough places, he might cause expensive damage to the mechanism. Damage varies so widely in different instances, even under the same abuse, that it is hard to make mechanical trouble the basis of any bonus system. The tires, on the other hand, reflect every abuse, and by their

condition and their length of life it is often possible to determine fairly accurately the care with which the driver has operated his truck. Moreover, if the driver is given to understand that his reward is based upon conditions and length of life of his tires, he will be encouraged to avoid overloading and overspeeding and other abuses, and he will not only give the best of care to his tires, but at the same time give the best of care to his truck.

A prominent manufacturer in writing to a motor truck magazine which conducted a symposium on the problem of truck overloading, states as his opinion that a bonus system based on tire mileage was the best cure for the evil:

"We said to the user, if the truck was not overloaded, was driven carefully over rough roads and handled sanely in bad places, his tires would last a whole lot longer and incidentally his truck would receive the same proportionate increase of life. It appeared to us that it would be good business for him to say to the driver that he would divide up with him any increase of mileage which he got over the regular tire guarantee of 7,000 miles. In other words, the user would be glad to pay the driver a bonus if he could show a greater mileage than the regular guarantee. For instance: If he makes 10,000 miles, the owner would pay the driver the actual cost of 1,500 miles.

"In this way the driver would not only drive carefully, but he would be inclined to stick to his job at least until the tires wore out, making him a steadier employee."

An Effective Ton-Mileage System. Perhaps the most complete and scientific bonus plan which has come to our attention recently is that in effect at the plant of the Timken-Detroit-Axle Company. This has been reported recently by the director of the Department of Standards for the Timken Company, and printed in *100%*, the efficiency magazine, Chicago.

Mr. Veale, of the Timken Company, hits the nail on the head when he says that almost any bonus or premium plan can be applied to the operation of motor trucks after you have found a satisfactory unit for gaging performance. The difficulty lies in selecting only such items as are under the driver's control, and eliminating such items as taxes, depreciation, interest, and so forth, which would prevent the scheme from working out justly to the driver.

The Timken Company has elaborated several forms for working out this system. These forms are admirably constructed, and are the result of considerable study. The basis, however, on which the entire plan rests is the ton-mile. This, as we have explained, simply means the hauling of one ton one

FIGURE 188: Step 1. The wagon is merely a frame to support a spare platform body. The horse has hauled it about the lumber yard and a load of laths has been assembled. Notice the stout eyebolts at the corners.

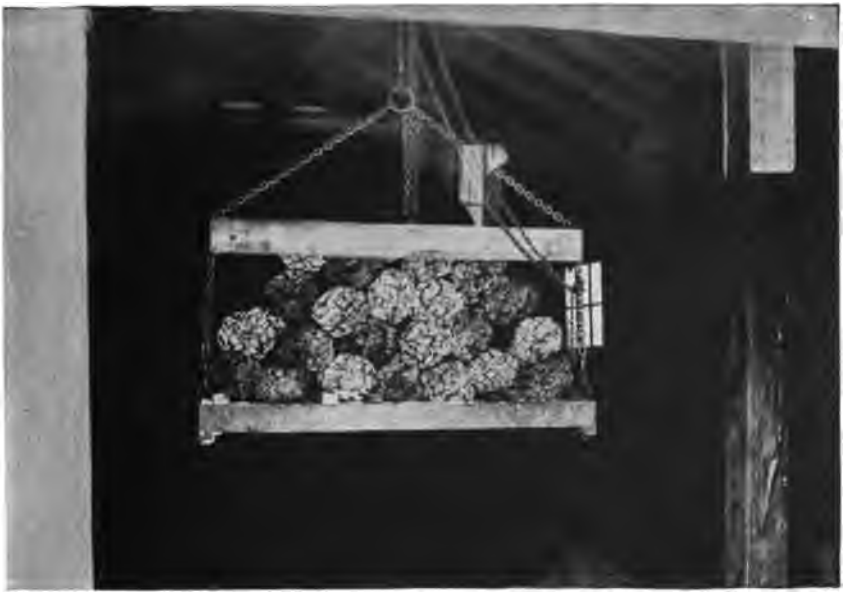


FIGURE 189: Step 2. The loaded body has been hoisted from the wagon by means of a chain-falls. The body hangs suspended, waiting for the truck. There is no need for the wagon, horse, and driver to wait for the truck.

FIGURE 190: Step 3. The truck has made its delivery and has returned empty. It stops outside the shed and its body is removed and put on the yard wagon. This body is an exact duplicate of the one shown on the opposite page.

FIGURE 191: Step 4. The truck now backs into the shed and under the suspended body which is lowered onto it. The truck is off again after a few minutes' wait. Meanwhile the yard wagon is assembling another load.

mile. Thus, if you take one ton five miles you will have five ton-miles, and likewise, if you carry five tons one mile you will get the same—five ton-miles. By dividing the total of all costs over which the operator has control, such as gasoline and oil consumed, the drivers' and helpers' wages, repairs, tire renewals, and so forth, by the number of ton-miles delivered, a rate per ton-mile is found, which may be compared with a fixed or average rate established by the company. Their drivers are then given a bonus amounting to 50% of the savings they can effect below the standard cost fixed by the company.

Mr. Veale says that after applying this system for a considerable period, it has resulted in increased loads (without overloading), higher percentage of operating time, and decreased cost. The plan discourages abuses of all kinds, and encourages "Safety First."

Mr. Veale says in this connection:

"During the past fifteen months since this plan has been in effect, we have accomplished an average saving of 30% on all our hauling and during the month of August, 1917, we operated five trucks at a trifle less expense than it cost to operate four trucks in June, 1916. With 30% increase in hauling capacity we actually hauled 70% more tonnage."

A Negative Bonus System. The coal company referred to in Chapter XV, which, by the use of recording devices discovered several different kinds of delays in the operation of their trucks, hit upon the plan of making this information the basis of a bonus system. This was especially easy, inasmuch as the recorder gave them, with specific accuracy, the number of delays and duration of each. In order to perfect a system, it was necessary, first, to ascertain the exact time consumed in loading trucks, making trips, and unloading. In the event that the driver in making his trips improved upon the standard time thus established, he was given credit for the time gained. The superintendent of the company has the following to say regarding this plan:

"All delays are recorded under 'remarks' and at the end of each month we can readily tell the percentage of delays attributed to stock, orders, loading, and wrong address troubles, also see at a glance whether the driver is having too many excuses for not making a perfect record. Bear in mind, each trouble is recorded, as the drivers are required to report each stop over two minutes to the yard manager or else the time lost is recorded against him under 'time lost on the road.' A chart is kept at each yard showing the daily average of each driver, and in the event a driver does not stop, going to or returning from destination, loads and unloads promptly, he is given a star for that's day work. If overtime is made he is paid for same on the basis of 25 cents an hour, but if time is lost on the road during the day, same is de-

ducted from his overtime. Six stars, or a perfect week's work, is rewarded by a bonus of $1.25.

"If less than six stars are made the bonus is figured on the basis of $1 a week, and each star made is equivalent to 16⅔ cents, but most all drivers are receiving the $1.25 a week bonus, also some overtime. For instance—say John Smith made 30 minutes overtime, lost 20 minutes on the road Monday, and made a perfect record the remainder of the week, he would be paid only 10 minutes overtime, and receive as a bonus five times 16⅔ cents, or 84 cents.

"It is necessary that we keep in close touch with our delivery problem, and we therefore have a chart at the office showing actual time made by all drivers, and we can tell at a glance the average efficiency of all drivers and also that of any one of our three yards."

Another Demerit Schedule for Bonuses. A system which, while having the same purpose as the bonus plan, was worked out on totally different lines, has been successfully installed by the superintendent of a large fleet of trucks in Chicago. This system, instead of involving rewards for unusual merit, was based on a schedule of demerits.

These demerits were expressed in points, and in that way it was possible to give different values to different faults—ten points, for instance, for some minor trouble, while accidents might bring demerits amounting to 70 or 100 points.

The demerits were based on complaints of two general kinds: first, with reference to delivery service, and second, with reference to mechanical troubles. Complaints under the first head came from the shipping clerk and complaint department; and under the second heading from the mechanical inspection report and other records which constituted the system of truck maintenance. The traffic superintendent gives an example of each kind of demerit as follows:

"Let us say that a driver has delivered two packages to a customer where three were called for. The chances are that the package which has not been delivered is just the one that the customer has been expecting. The result is that an extra trip has to be made to take care of that delivery. This is a serious mistake, and the driver should get twenty demerits, assuming that the route sheet which he carries with him showed plainly just how many packages should have been delivered. Suppose on the other hand, a driver has burned out a bearing on his truck. If he has neglected to make out the report showing that he was having trouble with this bearing, this is a serious fault and may be responsible for a repair bill which otherwise might have been avoided. On this basis it is proper to figure mechanical demerits according to the cost of the material and labor required to repair the part. On the other hand, if the trouble occurred through no fault of the driver, he should not be charged with the demerit.

"The success of this scheme was striking. While the drivers at first were inclined to think that the demerit system was hard on them, they soon began to realize that it was absolutely fair. The first month it was tried the winner had 1,050 demerits charged against him and the score of the low man ran into the thousands. Three months after the system had been in effect, two men tied for first place with no demerits at all. The plan had the effect of creating the finest kind of rivalry between the men. For instance, one driver would drop a piece of waste near an other fellow's truck and the other fellow would say: 'The first thing you know I will be getting demerits. I didn't throw that waste down and you had better get it out of the way.' In another case one driver lectured his helper because he allowed his engine to run unnecessarily, which would cause a higher record of gasoline consumption and thus affect his demerits."

The problem of getting the driver to take an interest in his truck will probably never be fully solved, but can be attacked with considerable success. The bonus system is the most direct way. Suggestions and instructions to the driver will help, but remember, some kind of cash incentive is the trump card. The driver has an investment worth thousands of dollars in his care and keep. It is worth while to play a little game with him in which he will take an interest. The unique position of this almost free agent requires it, and the investment at stake justifies it.

PART III

MAINTENANCE THAT LOWERS THE COST OF UPKEEP

CHAPTER XVII

WHAT UNDERLIES SOUND MOTOR TRUCK MAINTENANCE

HOW long will a truck last? One day or a dozen years? The question cannot be answered in terms of a definite period of time. On the one hand is the merchant who operates his truck with the sole idea of getting through with the day's job, without regard to the care and attention which it should receive, and who, at the end of the season, drives it to the scrap heap. On the other hand is a concern like Spaulding & Spaulding, of Buffalo, coal dealers, whose first trucks, bought in 1909, work as well nine years later as any of the trucks which it has purchased in succeeding years. (Figure 192.)

A well-known truck manufacturing concern, which has been building trucks ever since the industry started, announces that, to their knowledge, no truck of their make has ever worn out in service. This does not mean that not one of their trucks has been put out of commission. Trucks will plunge off of bridges, or get tangled up with street cars or locomotives, or again grow old in an hour through lack of oil. The statement has reference to natural wear and tear, not accidents, and presupposes that the truck has received ordinary care and attention. It means that long life has been built into the truck; that it has started with a vigorous constitution. This is all that could be expected of any truck manufacturer.

Proper Maintenance Retards Depreciation. We cannot answer the question: "How long will a truck last?" except by saying "That depends." It depends to a considerable extent on the quality of the truck—its constitution—somewhat on the work it is called upon to perform and the way in which it is handled. But most of all it depends on the attention it receives, its monthly, weekly, daily, even hourly care. *Maintenance* is the word which describes this care.

A locomotive, after each trip of 150 to 200 miles, is taken to the roundhouse. An expert mechanic goes over it, inspecting every part, trying every bolt with his wrench, sounding every rivet, testing every piece for looseness or play, adjusting this and tightening that until the engine is declared fit to travel another 150 miles over smooth rails and level track.

This is maintenance—a searching for troubles while they are still small in order to cure them before they become big. But if this is necessary in the case of the locomotive, consider how much more essential it is to the upkeep of the truck.

Trucks and Locomotives Compared. In every respect but one the motor truck encounters more serious mechanical difficulties than the locomotive. Its one advantage is in having wheels shod with rubber instead of steel, but even this advantage is more than offset by the character of the "track" over which it must travel, presenting ridges and depressions which, as we have shown in Chapter XXI, are like hills and valleys in comparison with the smooth surface of the steel rail. (Figure 229.)

Consider the operation of the two machines. The locomotive derives its power from expanding steam which shoves the huge pistons along at the rate of two or three hundred times a minute; the motor truck is urged on by explosions which occur thousands of times a minute. The locomotive is heavy, weighing perhaps more than a hundred tons, and absorbs the light shocks of the rail with little vibration; the motor truck is comparatively light, and when it encounters ridges, depressions, edges of bricks, car tracks, and thousands of other obstructions as it plunges over the road, it converts these shocks, together with the throbbing of its engine, into a ceaseless vibration which shakes every part of its mechanism from the radiator to the tail-light. Is it any wonder that bolts become loose, that bearings wear, and that the moving parts of this explosion-engine require an occasional tightening and adjustment?

And in addition there is the transmission gear-system, by which the power of the engine is manipulated to cope with the varying grades of the road; there is the system for pumping water and bringing it to the superheated sides of the engine; the clutch system which must stand the jerks with which the engine takes hold of its load; the lubricating system, sometimes involving a pump; the gasoline system, making use of fine pipes and valves fitted with the accuracy of a thousandth of an inch;

and the ignition system, employing scores of wires and using electrical instruments as sensitive and fine as any found in a jeweler's window. And all these systems with their various pipes, rods, gears, wires, valves, and pumps must be attached to the motor truck by bolts, bands, screws, stays, and supports of various kinds, all of which must be kept tight and in perfect alignment all the time. Were it not for the consideration of human life, it would not be necessary to inspect the locomotive with the care required for the proper maintenance of the truck.

The Ounce of Prevention. The truck owner will do well to face the problem as it is. It need not cause him alarm, because he will see on every side trucks which are poorly cared for for giving good service for three, five, or even ten years. Such is the stanchness of the modern truck that it will stand abuse which the first builders never dreamed of. But consider for a moment the additional years which can be added to the life of the motor truck by proper maintenance. In Chapter III we saw that the charge for depreciation against a 5-ton truck averages $2.50 a day. Suppose by careful maintenance the truck owner has added one year to the life of a truck. He has put more than $700 into his pocket as surely as if it were so much gold.

"A stitch in time saves nine." No better motto could be found to express the spirit and purpose of a proper system of truck maintenance. To catch a squeak while it is still a squeak, and remove the cause of the trouble before it has developed into a serious ailment, this is the essence of the problem. But as it is generally harder to diagnose an ailment than to prescribe for it once its nature is known, so in the care of the truck the most difficult work is not the actual maintenance, strictly considered, but the inspection which reveals what parts are in need of the mechanic's care. It is unthinkable that an intelligent truck owner should allow a mechanical trouble to go unattended to, provided he knows the trouble exists. On the other hand how many mechanical ailments spring up and develop into serious troubles before they come to the attention of the operator! As in the care of the human body, a dozen physicians can prescribe cleverly where only one can skilfully diagnose, so in the maintenance of the truck the work of repairing, replacing or adjusting the parts is secondary to the inspection which discovers what parts are in need of attention. *Inspection* is the basis of truck maintenance.

How to Find Mechanical Trouble. The first step in the constant search for mechanical troubles is to question the driver. While he may know little or nothing about the construction of his truck, he is in an excellent position to report on its general behavior. It should be remembered that he is operating the truck during the day under all conditions of stress and strain, and troubles or symptoms of troubles come to light on the road which might remain hidden during the inspection in the garage.

Perhaps the most satisfactory way of obtaining this information from the driver is by setting aside a space on the daily card for this purpose. In Chapter V we described the use of this card in reporting items of supplies and performance and presented, in Figure 37, drivers' cards used in different lines of business. Most of these cards carry on their face or reverse side a space which the driver can fill out, indicating mechanical troubles which appeared during the day. In Figure 193 are drivers' cards showing how this information may be jotted down by the driver.

Information the Driver Can Give. How much detail regarding mechanical troubles should be shown on the driver's cards? This depends on various factors. If the merchant owns one or two trucks and employs drivers who may have some mechanical knowledge, the card can be designed to call for considerable detailed information. The logic of this is clear when it is observed that the small truck owner depends largely upon his driver for the inspection and care of his truck, and if the driver's card were too simple the truck might fail to receive that detailed examination which it requires. On the other hand, if the operator employs one or more skilled mechanics, he should leave the detailed questions to them, asking the driver general questions which will not confuse or frighten him but will get from him a clew which may be followed up often with valuable results by the shop. An instructive example of this method is presented and fully discussed in the following chapter.

Inspection at the Garage. The report of the driver, which we have just discussed, is at the same time important but incomplete. It may reveal troubles which otherwise might not have been caught until a much later date; but on the other hand it is sure to omit mechanical ailments which only a minute and painstaking examination can bring to light. A more thorough inspection is required from time to time to safeguard the condition of the motor truck. This should be supplied in the garage.

Inspection Report of Motor Truck

Owner _____ Model _____ No. _____

Address _____ Customer's Number _____

Inspected at _____ Date _____

Motor

General Condition (cleanliness, and so forth) _____

_____

Operation _____

Compression _____

Leaks (oil, water, compression, and so forth) _____

_____

Adjustments recommended or done on valves, timing gears, carburetor, magneto, oiling and cooling systems, governor, and so forth _____

_____

_____

_____

_____

Transmission

Condition _____

Leaks _____

Oil level _____

Recommendations _____

_____

Clutch

Operation _____

Recommendations _____

Rear Axle

Oil level _____

Brakes _____

Truss Rod _____

Recommendations _____

General

Oil cups _____

Wheel bearings _____

Front Axle and connections _____

Steering Gear _____

Universal Joints _____

Frame _____

Springs _____

Tires _____

Miscellaneous _____

REMARKS and recommendations regarding care in general, loading, operation, and so forth

_____

_____

_____

_____

Service Manager _____ Inspector _____

Dealer _____ Dealer's Report _____

How often should this inspection take place, and how complete should it be?

Once more the circumstances surrounding each installation must be looked into before an answer can be made. The owner of a fleet of trucks can employ one or more skilled mechanics and set aside a day for each truck, when it can be taken off the road and given a thorough inspection. This inspection is generally given once a month, but one fleet owner, who operates 19 trucks, sets his inspection dates 19 working days apart, and another who owns 40 trucks inspects two trucks every day. The small owner, who perhaps cannot keep a mechanic busy, requires an inspection of a much simpler kind, undertaken at frequent intervals.

On Insert II are presented five inspection reports ranging from the comparatively simple one to the more complex report used by a Chicago haulage company which specifies 111 different parts and groups of parts which must be tested before the inspection is complete. It should not be difficult for any truck owner to select from this group a report which, with or without modifications, will suit his special needs.

Although a mechanic may be able to inspect a truck without the aid of an inspection report, such a form is often of great assistance. A well-designed inspection report presents the important parts of the truck in logical order, either grouping them according to the system to which they belong, or listing them in the order in which they are reached by the mechanic as he progresses in his examination from one end of the truck to the other. A notable example of this arrangement is presented in the following chapter. Such a report gives invaluable aid to the inexperienced operator, guiding him in his inspection and preventing him from overlooking any critical part.

The inspection of the electric truck is, of course, much different from that of the gasoline power wagon. As an electric truck does not have the reciprocating engine of the gasoline truck, with its gears, clutch, water, and gasoline systems, its maintenance is much simpler. On the other hand, its parts require considerable care, and must be inspected rigorously. The forms in Figures 194 and 195 provide for inspection of this kind.

A Striking Example of Proper Maintenance. At the beginning of this chapter we mentioned a Buffalo coal concern whose fleet of 5-ton gasoline trucks has occasioned comment

far beyond the limits of its own state. Buying its first truck in 1909, another in 1910, and 12 more in 1911, and additional trucks in succeeding years, its present fleet of 22 trucks give an example of care and maintenance which is rarely approached. The first truck they bought is in almost as good working condition as the last. Apparently this fleet is not subject to depreciation. Parts have been broken, others worn and replaced, but the trucks are there, working every day and it requires a reference to the records of the company to discover which truck has been running since 1909 and which since 1917.

How has this record been accomplished? Fred Nichols, who has charge of maintaining this fleet, tells the story in the charts in shown in Insert III.

Six charts, each headed with a working day of the week, are tacked on boards an inch thick, which hang on nails driven into the garage wall. On each chart appear specific instructions for the inspection of each truck each night.

A comparison of this chart with any of the inspection reports shown in Insert II will reveal some interesting facts. Mr. Nichols has eliminated the rigid monthly inspection and substituted for it a schedule of daily care and maintenance. This original method of maintenance has accomplished three important results, which are worthy of special emphasis.

1. Frequency of inspection has made each inspection much simpler than would have been the case if intervals of 20 or 30 days had been used.

2. Inspections were made still simpler by a division into six parts, for it will be observed that only a part of each truck is inspected each day, it requiring six days (or evenings) to cover the entire examination of the truck.

3. By the simplicity of this program the truck drivers were enabled to make the inspection themselves, and thus acquired a knowledge of their trucks and an interest in their care and upkeep which made them careful and conscientious guardians of the investment placed in their hands.

In addition to these maintenance charts Mr. Nichols devised an oiling schedule which has been described on pages 308 and 309.

How an Express Company Maintains Its Trucks. When a large fleet of trucks is operated from one point, the work of inspection and maintenance can be specialized to a high degree. Mr. Edward E. LaSchum, general superintendent of motor vehicle equipment for the American Express Company, tells of his system of maintenance as follows:*

*From *100%*, the efficiency magazine, August, 1917.

MONDAY

OIL IN MOTORS.

—•—

NO TRUCK MUST LEAVE GARAGE UNDER ANY CONSIDERATIONS WITH LESS THAN TWO INCHES OF OIL SHOWING IN GAUGE GLASS.

—•—

JACK FRONT WHEELS OFF GROUND; EXAMINE BEARINGS FOR PLAY; FILL AXLE PIVOT. GREASE CUPS. OIL ALL STEERING JOINTS: CALL MECHANIC'S ATTENTION TO ANY EXCESSIVE WEAR OR SLACK.

—•—

REFILL THE FOLLOWING GREASE CUPS:

4 ON FRONT SPRING PINS
2 ON RADIATOR BEARINGS
1 ON STARTING HANDLE
1 ON STEERING LEVER SPINDLE
2 ON TRANSMISSION SUPPORT TUBE BRACKETS

—•—

OIL BRAKE RODS AND JOINTS.

—•—

OIL GEAR SHIFT LEVERS.

WEDNESDAY

OIL IN MOTORS

—•—

ER FACES OF CLUTCHES WITH NEATS VD PROP AWAY FROM FLYWHEEL WITH DED.

—•—

TRANSMISSION AND PEDAL GEAR WITH

—•—

MECHANIC ANY LEAKY GASOLINE PIPES FOUND.

—•—

NIVERSAL JOINTS FOR WEAR, LOOSE TER PINS; ALSO HOIST COUNTER SHAFT

—•—

RCE GREASE THROUGH FOLLOWING CUPS:

CLUTCH SHAFT
END OF HOIST COUNTERSHAFT
END OF GEAR-SHIFT SHAFT
HOIST SPROCKET SHAFT BEARING

—•—

PERATING FORK LEVER, YOKES AND DOGS.

—•—

OPERATING SHAFT BEARINGS

—•—

ATHER DUST COVERS ARE FULL OF GREASE LLAR AROUND CLUTCH FORKS ARE TIGHT.

—•—

JOINTS. BRAKE RODS AND JOINTS, OIL EVERS.

THURSDAY

OIL IN MOTORS.

—•—

FILL AND FORCE GREASE THROUGH FOLLOWING GREASE CUPS:

2 REAR END OF TORQUE ROD
1 ON FRONT END OF TORQUE ROD
2 ON FOOT BRAKE CAM SHAFT
2 ON FOOT BRAKE SHOE PINS
1 ON INTERMEDIATE SHAFT BEARING
1 ON HOIST SPROCKET SHAFT BEARING

—•—

THIS IS A GOOD NIGHT TO FILL ALL LEATHER UNIVERSAL JOINT BAGS WITH GREASE.

—•—

OIL STEERING JOINTS, BRAKE RODS AND GEAR SHIFT LEVERS.

SATURDAY

OIL IN MOTORS.

—•—

OT BOARDS, SOAK LEATHER CLUTCH FACES OOT OIL, AND PROP AWAY FROM FLY-STICKS PROVIDED.

—•—

ECHANICS ANY LEAKY GASOLINE PIPES THAT D.

—•—

ERSAL JOINTS AND PINS FOR WEAR, LOOSE N LOCKING SCREWS, ALSO HOIST COUNT-HANISM.

—•—

SMISSIONS WITH GREASE UP TO UNDER SIDE T.

—•—

RATING FORK LEVERS, DOGS AND YOKES.

—•—

PERATING SHAFT BEARINGS.

—•—

EASE RAGS AROUND CLUTCHES ARE FULL D BRASS COLLAR IS TIGHT ON CLUTCH FORKS.

—•—

JOINTS, BRAKE ROD JOINTS AND GEAR

FIGURE 192: Maintenance has kept this fleet intact; the first truck, bought in 1909, was in commission nine years later. Not one of the 22 has been allowed to get in bad condition. On page 272 the superintendent explains how this was possible.

EXPENSES

Tolls and Sundries		Break-downs or repairs		REMARKS

REPORT — Parts needing repair or replacement.

Engine pounds on hills
Trouble with ignition

Watson

Operator's Daily Report

Truck Number 3 Date July 29

Driver Sherlock

Left 630 Returned 410

Odometer Reading Finish 5106 Gallons Gas

Odometer Reading Start 5070 Pints Oil 3

Mileage 36 Pounds Grease 2

Repairs Needed

Take up both brakes

O. K. W.T.M.

FIGURE 193: Maintenance depends to a great extent on getting a report early on a mechanical trouble. On the reverse side or even on the face of the driver's daily report card, space may be provided for this information.

WARD MOTOR VEHICLE CO.

NAME _____ CAR NO. _____

Painting	Gear	Wheels	Body	Varnish	Paint	Lettering	
A. H. Motor	Thermom.	Speedom.	Ch'geometr.	Filler	Odometer	Front Curtains	Rear Curtain
	Side Curtains	Cushion	Lazyback				

REPAIRS MADE

REMARKS:

EXPENSES:

CHARGING EQUIPMENT:

Motor Generator, K.W.	Volts	Mfgr.	Control
A. C. Service Voltage	Phase		Cycle
Rectifier Type	Rating	Mfgr.	Setting
A. C. Service Voltage			
D. C. Service Voltage	Resistance		Ohms
General Appearance of Battery:			
What Water is Used for Flushing:			
Was Battery Charged When Inspected:			
Temp. of Several Center Cells:			
Reversed Cells:			
Gravity—Low Cells:			
Voltage—Low Cells:			
How Charge Cut Off:			
Average Daily Mileage:			
Average Daily Charge:			
O. K.	Ass't Eng.	Signature	

FIGURE 194: The inspection of an electric truck is, of course, entirely different from that of a gasoline power truck. This inspection form and the one on the opposite page, may be relied upon to furnish the electric truck owner with all necessary data to insure proper maintenance in the operation of his trucks.

WARD MOTOR VEHICLE CO.

INSPECTION REPORT

DATE | CAR NO.

OWNER | ADDRESS

Type | Mileage | Battery

Battery Put in Service | No. Cells | No. S. F.

Removed | Washed | Electro. Replaced

Motor | Serial No.

Interviewed Mr.

Time Left Factory

Began Inspection | Finished Inspection

Returned Factory

Use following Code in making out Report: LOOSE, L; DENT, D; ALL RIGHT, O. K.; REQUIRES REPLACEMENT, R; POOR, P; GOOD, G; ADJUSTED, A; DIRTY, D; MISSING, M; SPLIT, S.

BODY	Panels	Sills	Dash	Roof	Doors	End Gate			
FRAME	R. Gusset'n	L. Gusset'n	R. Member	L. Member	Front	Rear	Batt. Cradle		
SPRINGS	Hangers R / L	Links R / L	Bolts R / L	Clips R / L	Gasket Bolt R / L	Eyes R / L	Leaves R / L	Clips R / L	
Front									
Rear									
STEERING GEAR	Lubricat'n	Adjustm't	Support	Wheel	Steer. Rod	Bolts	Swivels	Collars	
WHEELS	Lubricat'n R / L	Adjustm't R / L	Hub Cap R / L	Clips R / L	Spokes R / L	Felloes R / L	Hub Bolts R / L		
Front									
Rear									
TIRES	Size R / L	Length Serv. R / L	Make R / L	Condition R / L	Kind R / L	Bolts R / L			
Front									
Rear									
F. AXLE	Lubricat'n	Sp'dle Bolt	Tie Rod	Steer Arm	R. H. Spind.	L. H. Spindle			
R. AXLE	Lubricat'n	Out. Bear'g	Inner Bear.	Rear Cut	Pinion Bear.	Hous. Plug	Different'l	Housing	Shaft
CONTR'LR	Lubricat'n	Adjustm't	Drum	Contacts	Fingers	Forward	Reverse	Resist'ce	
WIRING	Motor Leads	Recep. L'd	Rem. Switch	Light Wire	Fuse Block	Light Sw.	Fr. Lamp—R.	Fr. Lamp—L.	Tail Lamp
BATTERY	Trays	Terminal	Jars	Covers	N. Plates	P. Plates	Separat'rs	Sediment	Electrol.
MOTOR	Door	Bearing Caps	Commutat.	Brushes	Dist. Rod	Fittings	Fields	Armature	
COUNTER-SHAFT	Lubricat'n	Adjustm't	Bearings	Different.	Chain Case	Dist. Rod	Dist. Rod Pin		
DRIVE	Motor Universal	Axle Universal	Lubricat'n	Adjustm't	Cups				
BRAKES	Adjustm't	Lining	Rods	Pins	Equalizer	Drums	Ratchet		
R. Wheel									
Transmiss.									
SPROCKETS	Motor Chain	Motor Pinion	C. S. Sprock.	R. S. Sprock.	L. S. Sprock.	R. R. Sprock.	L. R. Sprock.	Side Ch.	
CHAINS									

FIGURE 195: Even though an electric truck does not have the reciprocating engine of the gasoline truck with its gears, clutches, water, and gasoline systems, nevertheless its parts require great care and close inspection. This inspection form may well serve as a maintenance guide.

FIGURE 196: This dump body can be operated without a hydraulic or mechanical hoist, or without even a train of gears. A quick thrust on a lever is sufficient. The extended reach of the bucket insures the load falling clear of the wheels.

FIGURE 197: As the body of this truck is elevated the tailgate is opened wider and wider by means of a rod which runs lengthwise along the rounded edge of the body. The entire operation is automatic, and the driver need not leave his seat.

"When a truck arrives at the garage, the driver is required to enter in a book provided for the purpose a report of the day's trouble, if he has had any. He briefly tells what needs attention, and the garage foreman must see that the necessary attention is given.

"In addition to this, a truck arriving at the garage is immediately taken by a trained inspector who is a trouble hunter and a trouble eliminator. It is his duty to see that all loose nuts are tightened, that the lubrication is right; to note any abuse to which the vehicle may have been subjected, and to make a report of its condition and the attention needed. By this method many things are caught and 'the stitch in time' taken, thereby avoiding unnecessary delay and expense.

"Expert carbureter men are employed who devote their time to correct adjustment, which gives perfect combustion; thus carbon is eliminated and economy in fuel consumption is the result.

"The work is broadly divided under the head of the garage and the shop, each with its own superintendent. There are three shifts of inspectors, namely: 8:00 a. m. to 4:30 p. m.; 4:00 p. m. to 12:30 a. m.; and 12:00 midnight to 8:30 a. m.; each shift overlapping a half-hour so that there is no interruption of the work while one shift stops work and the other starts.

"The drivers, who are employed by and supervised by the transportation department, work on two shifts of from ten hours to as much more as may be necessary to maintain the 24-hour service of the American Express. While they do not have stated times of return to the garage, the variation from day to day is not great, so that each truck is assigned to the same inspector upon its return every day.

"Each inspector is responsible for from four to ten trucks, according to age, the newer trucks being assigned in the greater numbers owing to their relative freedom from trouble of a serious nature. Each inspector is a godfather to his trucks, and is entirely responsible for their condition, efficiency and reliability both in the garage and on the road."

Symptoms that Indicate Trouble. A first aid to the inspection report is a table of symptoms. As the physician determines from the pulse, the tongue, the eye, the breathing, or the touch of the hand, the condition of the patient, in the same way the mechanic diagnoses the condition of the motor truck from squeaks, knocks, hisses, pounds, and other symptoms which it gives forth when in operation. Mechanical ailments, like bodily ills, are often hidden and are only discovered by some outward manifestations which at first are not readily connected with the troubles which occasion it.

The expert mechanic disdains the assistance of a printed form giving such symptoms, but he makes constant use of them nevertheless, for he has learned them by heart and applies them unconsciously in arriving at his conclusions. The driver, or the truck owner who wishes to oversee the maintenance of his

trucks, can lean heavily on such a printed aid. The inspection report may be checked off without uncovering a hidden ailment, but a symptom is not silenced until the proper steps have been taken to correct the trouble which it advertises. Several tables of symptoms are to be had for the asking by the truck owner who is genuinely interested in maintaining his equipment.

How About the Overhaul? Some truck operators lay their trucks up once a year and subject them to a thorough overhauling. The body is taken off, the engine is lifted out, the pistons removed, the transmission disassembled, and every part subjected to a careful scrutiny. The smallest defect is remedied, new parts are supplied, old parts readjusted, and the truck is put together again, in perfect trim for another year's work.

How often should this overhauling be performed, and what place should it hold in the maintenance of the motor truck? There are two theories which we summarize as follows:

One theory holds that the periodic overhaul is a necessary supplement to any system of regular inspection. It is not practicable to inspect a truck once a month in a manner that will disclose every mechanical weakness. Moreover, it is often not practicable or economical to replace parts the minute they begin to show wear. This should be done at periodic intervals, such as every year, or every 10,000 miles.

The other theory is that the periodic overhaul is illogical, inasmuch as it is an admission that certain mechanical troubles have escaped the regular inspections. It is contended that the monthly inspection should be so rigid as to detect every ailment at its inception. Mr. LaSchum, whom we have already quoted, says: "We do not believe in the periodic overhaul. The American Express Company's trucks are maintained as they go."

The determining factor is evidently the thoroughness of the monthly inspection. If the truck operator is equipped to give his trucks a rigid inspection at intervals of every few weeks, the periodic overhaul will become unnecessary and useless. But consider the owner of one truck, who depends upon his driver to maintain it. If he cannot make satisfactory arrangments with some mechanic to inspect his truck regularly, he is forced to fall back upon the periodic overhaul in order to take care of troubles which escaped his driver's attention during the year.

Making Use of Maintenance Data. No discussion of the principles of truck maintenance would be complete which did

not direct attention to the use which can be made of the facts brought to light in the course of keeping a truck or a fleet of trucks in repair for an extended period of time. In Chapters III, IV, and V, we saw that maintenance is one of the regular items of expense in the operation of motor trucks, and should be entered in the expense account along with gasoline, oil, wages, and other charges. The expense of maintenance, while properly appearing in the general budget, should, however, be made the subject of a special accounting as well, for in that way the cost of repairs, replacements, adjustments, and so on, can be made to tell volumes regarding the delivery equipment which the merchant has selected as well as shape a policy for future purchases.

MONTHLY SUMMARY OF REPAIRS AND MAINTENANCE

191_____ Truck Number _____

	Class of Service	Months in Use	COST				Mileage
			Material	Labor	Total	per Mile	
Forward							
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Total per Year							
Grand Total							

FIGURE 198: This form when properly filled out tells the truck owner many significant facts, all of which have an important bearing on the cost of upkeep. It shows by months the exact maintenance of each truck for one year.

Figure 198 provides a convenient summary for entering the expense of maintaining one truck one year. The expense is entered by totals for each month, and a grand total at the bottom

gives the maintenance charge for the year. This form, when properly filled out, tells the owner many significant facts. For instance, the kind of service in which the truck is used has an important bearing on the cost of upkeep; the months in use is a factor which must not be overlooked; the relation of material used to labor cost is significant and may reflect poor stock in the truck or on the other hand wasteful labor and poor facilities in the repair shop. Again, the mileage actually covered is a good check on the "months in use," which otherwise might be a misleading factor. Finally, the cost of maintenance for different months may disclose a tendency to neglect the truck, or may furnish a clew which will lead up to the truck driver, or again may reflect the influence of weather conditions which the owner may find it worth while to take into consideration.

Advantages of Yearly Charts. It is obvious that the facts learned by keeping a maintenance record by months can be entered on a form covering a number of years, and in this way facts of a different kind can be brought to light. Tendencies which appear faintly on the monthly record will stand out in bold relief in the yearly chart. Suppose for instance, that the cost of maintenance for the first three years averages $200 annually, but in the fourth year jumps to $500 and the fifth year to $800. It is obvious that acute depreciation has set in and that the time is near at hand when it will be profitable for the owner to discard his old truck and buy a new one. The yearly chart warns the truck operator that such a time is approaching, and enables him to determine with considerable accuracy when that time is at hand.

Maintenance records can be analyzed still more thoroughly. Thus it is possible to keep a record of the cost of maintaining certain parts of a truck, and in that way determine whether some parts are giving excessive trouble. From this the owner can draw still more important conclusions, and is enabled even to judge the design of certain trucks, and to determine whether they are adapted to the peculiar haulage conditions found in his business. One truck can be compared with another of the same make, or of different makes, and a program for future purchases laid down which has the support of figures which are so accurate, which cover such a broad experience, that they are dependable to the highest degree.

CHAPTER XVIII

HOW ONE MAN SOLVED THE MAINTENANCE PROBLEM

NOW that we have examined the basic principles which underlie effective maintenance, and their adaptation to small and large truck fleets, it will be profitable to see how a well-designed maintenance system actually works. For our purposes there is perhaps no better example than the truck installation of the Texas Company, oil producers of national reputation. This company operates a fleet of over 600 motor trucks. Consequently it had to solve those problems of general supervision which face the large fleet owner. But these trucks are scattered over 35 states of the Union, and are operated in groups of varying size. Hence, the Texas Company had to solve the problems of the small operator, and, in some cities, of the operator who could be classed as neither large nor small.

Authoritative Ideas on Maintenance Systems. B. B. Lipsner, of Chicago, now Captain Lipsner, who had much to do with originating and installing this system, was relinquished by the Texas Company at the call of the United States Government to serve as one of a body of experts to assist in the maintenance of motors used by American aviators during the war with Germany, tells the story in his own words. He unfolds step by step the successive phases of the problem, a problem which varies at every turn, and tells how a system was evolved which assured proper maintenance to small and medium-sized groups of trucks and proper supervision over large fleets.

"Keeping a fleet of 600 trucks in A-1 condition is one thing when all the trucks are operated in a single large city. It is quite another thing when these trucks are scattered from Maine to the Gulf, running over the roads of 35 different states, hundreds and even thousands of miles away from any central headquarters. Personal supervision must be replaced, in most cases, by supervision by mail, and forms must be devised which tell headquarters the condition of hundreds of trucks in widely separated localities. And

these forms, coming from different superintendents, mechanics, and drivers, must all use the same terms, and all speak the same language. They must be devised to cover all contingencies, and at the same time they must be simple. Each individual question which they ask must have a definite meaning. There is no room for mistakes.

The District Superintendents

"The entire territory is divided into five districts, each district having a superintendent who is responsible for the maintenance of all trucks in his territory. The district cities are Boston, New York, Chicago, Philadelphia, and Norfolk, Virginia. Here are located garages with repair shops equipped to handle all repairs from the simplest to the most difficult. The repair shop is in charge of an inspecting foreman, who is a skilled inspector.

"In cities other than the district centers, smaller garages are maintained, and the equipment is not so elaborate. But large or small, the same uniform system is put ready-made into the hands of the foremen in charge, the same inspection and maintenance is carried on, and uniform results are obtained.

First Step is the Driver's Card

"It is generally an easy matter to prescribe for a mechanical trouble if we know what it is. But the first job is to find out that a trouble exists, to determine its location, and how serious it is. This is the most difficult problem in truck maintenance. It can only be solved by a program of inspection which is broadly planned and rigorously executed. Accordingly I have made inspection the basis of my system of maintenance.

"It is unwise to neglect any source of information which may help to uncover a hidden mechanical trouble—least of all the driver. Some truck owners leave the driver entirely out of the case. Others ask him questions which are too technical for him to understand.

"I have chosen a middle ground for reasons which I will explain shortly, and accordingly have made the first step in my system: The chauffeur's daily report card. (Figure 199.) The lower half gives ten items indicating work done and supplies used, and need not engage our attention at this time. The upper half contains ten vital questions regarding the mechanical condition of the truck which the driver answers at the end of his day's work.

Ten Simple but Searching Questions

"At first glance these questions seem too simple to be of value in running down complex mechanical troubles. Take for instance Question 1: 'Does truck lack power?' What could be more elementary than that? But let us look into the matter a little deeper. If you question an able mechanic, he will tell you that the engine may lack power for a number of reasons. Here are only a few of them:

Spark plug gaps not properly adjusted
One or more valves leaking
Fuel mixture too lean
Insufficient lubrication
Improper grade of oil
Breaker points need adjustment or renewal

Brakes not entirely released, or dragging
Excessive carbon accumulation

"What does the driver know about these things? Practically nothing. If you were to question him every evening about the condition of the carbureter, or as to whether the valves were properly seated, or the spark plugs in perfect order, he might give you an opinion. If you put such questions into a daily

CHAUFFEUR'S DAILY ○ REPORT CARD

Date_____ 191__

Truck Number_____

Mark X to the following questions if same are found O K. otherwise mention number of question and give full details on reverse side.

1	Does truck lack power?	
2	Are brakes working properly?	
3	Does clutch engage smoothly?	
4	Are lights working properly?	
5	Is engine clean?	
6	Does truck squeak?	
7	Does truck rattle?	
8	Are wheel bearings properly adjusted?	
9	Does truck leak anywhere?	
10	Is truck equipped with fire extinguisher?	

Driver's Signature

FIGURE 199: Here are the ten simple but searching questions which the Texas Company asks its drivers every day. The answers often contain tips which the mechanics follow up to advantage, saving thousands of dollars a year.

test, he might check them off, or try to bluff them through. He might indicate that certain troubles existed when the truck was in perfect running order. Or, again, he might be scared away from mentioning any faults and give the truck a clean bill when several parts might stand in need of adjustment.

What Does the Driver Know?

"He knows better than any man on earth whether or not the engine lacks power. And this is precisely what the owner wants to learn, because this question is the key to a group of conditions, any one of which may be responsible for the lack of power which the driver has reported. If the engine lacks power, something is the matter. What that something is will be found by inspection at the shop.

"But, aside from the fact that lack of power is one of the most important symptoms of troubles which the motor truck can exhibit, take the question by itself. What does lack of power mean in terms of service to the customer? It means that the truck has not covered its territory in the time allotted for it. This means that the driver has been unable to deliver his goods on schedule

time, has kept customers waiting, or has been obliged perhaps to omit certain deliveries entirely. So you will see that this question, which seems so simple, is very important. Vital as it is, however, it can be answered by any driver truthfully, without hesitation, by a mere 'yes' or 'no.'

"Take the second question. What is more important than to know that the brakes are in perfect working order? On them depends the safety of the driver and the trucks. If the brakes fail, you may look for accidents. And accidents lead to three kinds of expense at least: First, repairs; second, damages; and third, an interruption of service. Then there is a possibility of trouble with the insurance company, because brakes should be inspected from time to time, and kept in good working order. If you can prove that you habitually look after your brakes, so much the better for you when the question of insurance comes up for settlement.

Getting Information from the Driver

"Consider now the manner in which the question may be put. Suppose we ask he driver: 'Are the left and right brake shoes properly adjusted?" The driver is puzzled. He cannot answer the question in the terms in which it is put, so he doesn't answer it at all, and you fail to receive information which might mean hundreds of dollars to you. But the question—'Are the brakes working properly?' is easy to answer. And the driver answers it, even if the trouble he is experiencing is of the most insignificant character.

Question 3

" 'Does clutch engage smoothly?' Here is another question which the driver can answer without difficulty. If the engine turns without transmitting the power to the rear wheels, the driver knows at once that the clutch is slipping. A slipping clutch, no matter of what construction it is, means hastened wear and a frequent renewal of the frictional surfaces. It means also that the truck is not getting over the territory with the customary dispatch—another case of interrupted service.

"Suppose the clutch is 'harsh.' When a harsh clutch is engaged the truck acts like a bucking bronco. The engine, with the momentum of its heavy flywheel, 'takes hold all at once' on the transmission and the gears. The propeller shaft, the universal joint, the worm, even the engine itself is racked and shaken by the sudden impact. Moreover, the tires, strained by the sudden action of the tractive force, may be peeled off.

"Perhaps a week hence the inspector will find a bent shaft, or a broken gear. But today the abuse is going on which will cause that breakage. The driver's answer to this simple question prevents a trouble in the future, by calling attention to what is merely a symptom at present. 'An ounce of prevention is worth a pound of cure.'

Question 4

"'Are lights working properly?' Every city or town of any size has an ordinance requiring that vehicles be properly lighted at night. These requirements generally specify as a minimum two sidelights and one tail-light. If these lights are not provided, your driver is subject to arrest—and there is

another interruption to service. He may have an accident, and there will be no recourse for you at law. This little question is a constant check on this important item. It calls for a simple 'yes' or 'no.'

Question 5

" 'Is engine clean?' Some persons will say that this does not matter. But a man placed in charge of an expensive piece of machinery like a motor truck should have enough pride in his work to keep his engine clean. Cleanliness has a psychological reaction, and often means care. But what about the man who leaves his truck grimy and dirty? Is it likely that he gives it the best of care? By means of a compressed air tank and a can of kerosene the driver can clean the mechanism of his truck in six or seven minutes. Question 5 checks him up on it.

Question 6

" 'Does truck squeak?' Here is a question that caused a lot of comment at first. It seemed peculiar, almost funny. But let us investigate. What does a squeak mean? Lack of oil. We know that if metal surfaces rub together without an intervening film of oil, destruction follows. A squeak is the mechanical symptom of such a condition. Ask the driver if this and that part is properly lubricated, and the chances are he cannot tell you. But he knows whether the truck squeaks. Ask him that, and if he answers 'yes,' the mechanic will not rest until he has located the trouble and supplied the necessary lubrication.

Question 7

" 'Does truck rattle?' is another queer question—at first glance. When you ask yourself, however, 'what is a rattle?'—the matter becomes more serious. A rattle is an indication that a certain component part of the truck mechanism is loose and that vibratory strains are passing through the molecules of the steel. Fatigue is setting in, and after that crystallization, not only in the loose part, but the tight part against which it strikes. And when the parts of a truck have become crystallized, they are no longer subject to repair—they must be replaced. Again, the driver may not be able to locate a rattle. He has done his part in telling you that such a condition exists.

Question 8

" 'Are wheel bearings properly adjusted?' If the truck is a light one, the driver can take hold of the wheel with his hands and by exerting pressure tell whether there is any play in the bearings. In the case of a heavy truck, where it is impossible to rock the wheel by hand pressure, let the helper take a few minutes' time and observe the action of the wheel as the truck rolls ahead.

"What is the importance of this test from the point of view of truck maintenance? If wheels are improperly adjusted, the tires may wear out in a month or even a week. The wheel bearings will also be subject to excessive wear. The brakes are liable to scar the drums because of lateral play, which, in turn, will react on the brakes themselves, producing excessive wear. These troubles may not develop for weeks or months; but the cause can be removed today if you check it up today.

Question 9

" 'Does truck leak anywhere?' is a simple question. While a day's loss in gasoline spilled on the road may not amount to much, a year's loss may be considerable. Then there is the added danger of fire. While such a matter is often followed up by the observant mechanic, it should be checked up every day. The question on the card makes this almost automatic.

Question 10

" 'Is truck equipped with fire extinguisher?' is especially called for in the case of tank trucks hauling gasoline and oil. But it is a wise precaution to have an extinguisher on any kind of truck. Blazes sometimes start from a short circuit or a leaky gasoline tank which will consume the truck, if the driver does not have an extinguisher ready for action. Insurance companies quote preferential rates to trucks so equipped. Question 10 makes sure that the fire extinguisher is not misplaced, but is ready for action when it is needed.

"I have explained these ten questions at length because they have an important bearing on my system of truck maintenance. They draw from the driver information which he is able to give, and do not confuse him by asking technical questions which he cannot answer. He doesn't need to bluff them through. He can answer them at once. And his answers are important clews, which, when followed up, prevent troubles which might otherwise take a heavy toll in dollars and cents from the pocket of the truck operator.

What Becomes of the Card?

"It doesn't take the driver long to fill out his card. He is not held up by a perplexing task when he is tired and wants to go home. He answers the simple but important questions and hangs the card up on a bulletin board, on which there is a hook for each card.

"The night mechanic in charge next takes it up. If any symptom is reported, it is run to earth. The cards are filled out for a purpose, and every trouble must be followed up *at once*. When everything has been taken care of, the mechanic puts his O. K. on the back. When I receive that O. K. I know that any troubles that were reported were taken care of that night, and the truck started out in first-class condition the next morning. The card goes to the garage office, and at the end of the month is mailed to headquarters, where it gives valuable information, as will be explained later.

The Monthly Inspection

"It must not be supposed that the driver's report of mechanical troubles and the follow-up by the garage mechanic constitute the sole inspection of the trucks. The daily inspection is an excellent safeguard against serious trouble, but a finer, more thorough inspection is required from time to time. This is taken care of by the large inspection service report shown in Figure 200.

"Each day, if the size of the fleet permits, or at intervals of not more than a month, one truck is brought in for inspection. Guided by the chart, an expert mechanic goes over every part of the truck, regardless of whether trouble has been reported previously or not.

"Before I describe the actual work of inspection, I want to call your attention to some of the items which appear in the heading of the report. The

THE TEXAS COMPANY

INSPECTION SERVICE REPORT

Agent _____ Station _____

Name of Vehicle _____ Repair Card Number _____ Date _____

Our Number of Vehicle _____ Factory Number _____ Chauffeur _____

Motive Power _____ Horse-power _____ Employed _____

Capacity _____ Type _____ Efficiency _____ Demerits _____

Instrument _____ Total Mileage

Truck Inspected Working at _____ Reading _____

Placed in service _____

Following Conditions Found — Grade Oil Used _____

		X	O			X	O			X	O
1	Bumper, Hood, Cover			31	Grease Cups			61	Plates		
2	Starting Crank			32	Frame Subframe Cross Member			62	Universal Joints, Drive Shafts		
3	Compression, Pistons, Rings			33	Wheel Bearings Front R.L. Wheel Bearings Rear R.L.			63	Muffler, Cut-out		
4	Motor Bearings M.R.			34	Mud Guards R.L. Running Boards R.L.			64	Front Sprocket, Chain		
5	Radiator, Supports			35	Spindles Dust Caps F.R.			65	Rear Sprocket, Chain		
6	Water—Pump, Connections			36	Clutch—Leather, Disks			66	Jack Shaft, Bearings		
7	Fan, Belt			37	Spring Thrust, Bearings				Equipment Details, Accessories, etc.		
8	Cylinders, Manifold, Priming Cocks			38	Throw-out			67	Tires—Front, Rear R.L.		
9	Oiling System			39	Foot Pedal, Clutch Brake			68	Battery—Box, Gravity		
10	Oil Gage, Sight			40	Transmission—Lubrication, Planetary			69	Sidelights—Wiring, Bracket		
11	Crank, Case, Oil			41	Case, Bearings			70	Wind Shield—Dash, Fire Extinguisher		
12	Oil Level			42	Supports			71	Lighting Switch, Horn		
13	Valves—Guides, Push Rods			43	Gear Shift Lever—Rods, Bands, Lining			72	Cab—Supports, Stakes		
14	Governor, Connections			44	Shafts—Main, Counter, Rev			73	Cushions, Curtains		
15	Plugs, Wiring			45	Gears, Bearings			74	Body, Floor Boards		
16	Magneto, Breaker Points			46	Intermediate, Flexible			75	Tank Supports		
17	Coil, Battery			47	Radius Rod R.L.			76	Connections, Piping		
18	Ignition, Distributor Brush			48	Torque Rod			77	Baffle Plates, Faucets		
19	Carburetor, Connections			49	Rear Spring R. L. Bolt R.L.			78	Filling Hose—Can Compartment		
20	Gasoline Line, Drip Pan			50	Spring Leaves, Clips Shackles, Bolt R.L.			79	Funnels, Cans, Skids		
21	Gas Tank, Supports, Strainer			51	Auxiliary Spring			80	Dome Caps, Gaskets		
22	Primer Pipes			52	Support			81	Licenses, Bracket		
23	Front Axle			53	Service Brake, Lining			82	State Number Plates F.		
24	Knuckle, Pin, Bushings			54	Emergency Brake Lever, Lining Emergency Brake Cams R.L.			83	State Number Plates R.		
25	Steering Wheel, Steering Arm, Ball Joints,			55	Brake Rods—Adjusting End, Brake Drums R. L.			84	Vehicle Plates		
26	Drag Link, Tie Bar			56	Rod End, Clevis Pins			85	Oil Pedlar Plates		
27	Steering Post, Steering Gear			57	Distance Rod Adjustment Equalizing Rod Pins			86	Taillight—Wiring, Bracket		
28	Front Spring R.L. Bolt R. L.			58	Rear Axle, Housing, Differential, Lubrication			87			
29	Spring Leaves, Clips			59	Worm Thrust Bearings			88			
30	Shackles, Bolt R.L.			60	Axles, Driving Dogs			89			

Marked X Required attention and were adjusted — **Marked O** Requires new part

FIGURE 200: Here are 86 vital points in a truck which need regular inspection. Moreover, they are arranged in logical order. This form was devised not for any special make of truck. It had to cover various makes in a large fleet. Hence you will find it of practical value to you in your business.

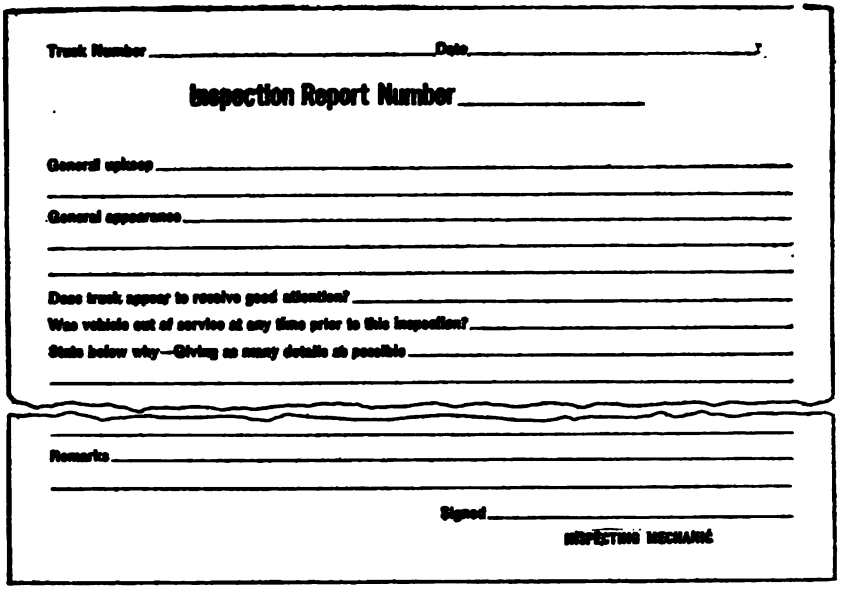


FIGURE 201: This is the reverse side of Figure 200, and is used to follow up particular questions with general ones which seek information of a different kind. These questions seem simple, but they often bring out valuable clews.

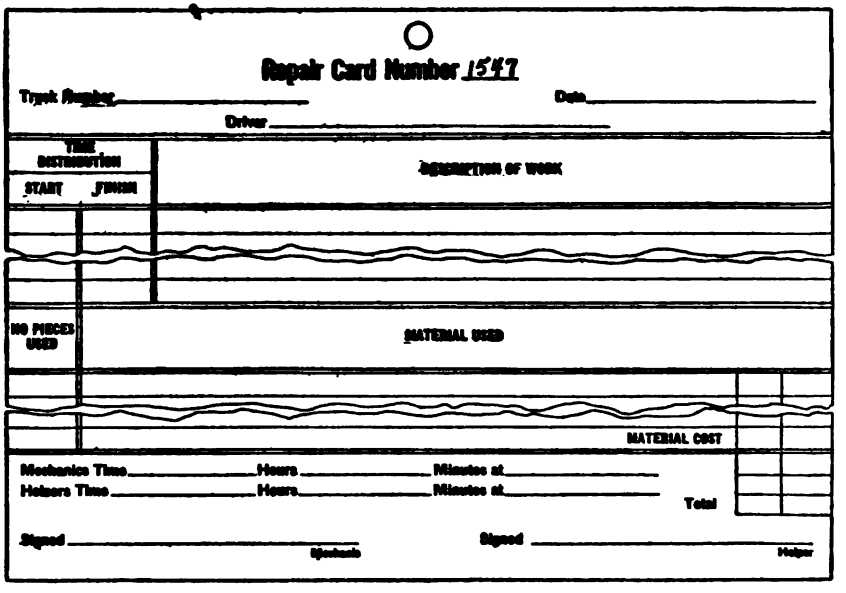


FIGURE 202: This repair card tells the essential facts of material cost and labor cost. It also identifies the truck, driver, mechanic, helper, and gives a full description of the job. It is invaluable in keeping an accurate cost of operation.

purpose of these items is to identify the truck and the inspection in every way possible. Thus, the number of the engine as well as that of the truck is given. We have spare engines, and often find it advisable to substitute an engine rather than hold the truck out of service for an extensive repair. It is well to have a complete description of the truck on this report, as often I compare two reports without reference to other records; hence such items as Name of Vehicle, Motive Power, H.-P. Capacity, etc. The chauffeur's name should appear, as well as the date when he was employed. The repair card number should check with the job card number which was used on the date of the inspection. Grade of oil used may have a bearing on certain troubles which are often repeated; and the date placed in service enables me to judge the report as a whole, for old trucks give more troubles than new ones but certain troubles reported on a new truck require an immediate investigation.

Logical Arrangement of the Inspection

"Notice that item No. 1 is the bumper, and the last item No. 86 is the tail-light. The various items have all been arranged in sequence, so that an inspector beginning at the front end of the truck can examine every part in order, without retracing a step. For example, as he stands in front of the truck, ready to begin his inspection, he examines No. 1, the bumper and the hood. He leans over and takes hold of the starting crank, No. 2. As he gives it a turn he is able to tell whether the compression, No. 3, is O. K., which, of course, indicates whether the pistons are in good working order. The manner in which the engine turns shows him the condition of the motor bearings, No. 4. Next his eyes fall on the radiator supports, No. 5; he lifts the hood and inspects the water pump connections, No. 6, from which point he goes naturally to the fan belt, No. 7, and the motor cylinders, No. 8, and so on until he finishes with the license plate and the tail-lamp supports. An exception is made in the case of accessories. These are all grouped between numbers 67 and 86. This is advisable because most of them do not affect the mechanical operation of the truck. This logical arrangement makes for speed in inspection without detracting from thoroughness.

How the Inspection is Conducted

"A blackboard, six feet square, fixed to the wall of the repair shop, presents an exact reproduction of the inspection report; moreover, this report is also reproduced on a slate, which is kept by the inspector. As the inspection mechanic brings to light defects which require attention, he makes an oblique line against the items in question on his slate. Let us say, for instance, that the radiator needs attention. The mechanic draws a line thus: / on his slate opposite the item 'radiator' and underlines it. When he has completed his examination, he copies the same checkmarks on the blackboard with a crayon. Then he erases the slate, which is ready for the next day's inspection.

"The shop force is divided in two sections: those working from the front to the middle section of the truck, and those working from the mid-section to the rear. Thus each group specializes in one branch of work. Generally four men constitute the force, two mechanics, each with a helper. The helpers, by the way, are often used to make extra or emergency deliveries, and are competent drivers.

"When a workman finishes the particular job at which he is engaged, he goes to the blackboard, and with a piece of crayon completes the cross × against the item in question. This tends to keep one man from jumping in on another man's work. When all the work is completed which the inspecting mechanic entered as needing attention, the inspecting foreman takes a blank Inspection Report and makes a copy of what appears on the blackboard. When this is done, each mechanic puts his initials against the items which he worked on. Thus, if any repair or adjustment fails to hold up, I can put my finger on the mechanic who did the work; and if the same trouble appears two or three times, either the mechanic is at fault or the part is very defective. An investigation will disclose the real cause.

The Back of the Report

"After the inspection is complete, the inspecting mechanic turns the report over and answers five simple questions which appear on the reverse side. Each of these questions has a meaning, as I shall show. (Figure 201.)

General Upkeep

"Any good mechanic can tell at a glance whether a truck has been maintained in good mechanical condition. Here the mechanic checks the driver.

General Appearance

"This tells me whether the truck is in good condition with regard to paint, varnish, and the like. A well-groomed truck makes a favorable impression with the trade and is a continual advertisement on the road.

Does Truck Appear to Receive Good Attention?

'This is a repeater and a double check.

Was Vehicle Ever Out of Service Prior to this Inspection?

"This is the most important question of all, for the answer may give me a cule which will lead to an interesting investigation. I find out when the truck was laid up, why, what part gave the trouble, what mechanic made the repair. The mechanic jots down the necessary references after the fifth question, which, as you will see, is entitled: State below why—giving as many details as possible.

"Then there is a space for remarks, in which the foreman enters the material and labor cost for that inspection. This enables me to compare one inspection with that of the month previous, or still farther back, from which I can determine whether material or labor costs have been increased. An investigation tells why.

The Place of the Repair Card

"In connection with the work of maintaining the truck, a repair card is used. (Figure 202.) This card is headed with a job number, and also bears the truck number, the name of the driver, and the date. The body of the card gives: First, a description of the work; second, description of material used and its cost; and third, time of mechanic and other helpers, with cost. Of course the material used must check with the requisitions that have been issued on the stock room. The first section identifies the work, the second and third give the cost of material and labor and the columns are so arranged that simple

addition of the extensions gives the total cost. This cost is, of course, charged against the truck and is kept in the permanent records. After this card is made out, it is signed by the mechanic and the helper, and mailed to headquarters.

"These forms, briefly described, are the 'clerical tools' of maintenance. They should be considered as guides directing, in a hundred different ways, the efforts of willing drivers, mechanics and foremen. They indicate the most direct path, and establish maintenance on schedule.

"But we have considered these forms from the point of view of the man on the ground, that is to say, the individual operator. Let us now consider the same forms from the point of view of the man at headquarters, who is responsible for the care and maintenance of these various installations, which, taken together, constitute a large fleet. Like other men he cannot be in two places at once. He cannot see what is actually going on at the various stations in various parts of the country. He can only depend on the information he receives on forms he designed for the purpose. Let us see what these forms can be made to tell him. The proof of the pudding is in the eating, and the test of any maintenance system is freedom from mechanical troubles.

"On my desk I have a book, the cover of which is labeled, 'Record of Mechanical Troubles.' Each page is devoted to a certain section of the truck, such as frame assembly, engine assembly, rear axles, and so forth, and at the top I show a drawing, which I take from the repair catalog of the concern in question. This enables me to note the defect at the exact point where it has taken place, and if it is very serious, an actual photograph is taken and attached to the page. Under the illustration on this page appear the six headings as shown in Figure 203. Let us suppose it is opened to a page headed as follows:

Item 36—Clutch

"How much trouble has been caused by the simple item of clutch disks throughout all the fleet all over the country?"

"The inspection reports for a year back show that 120 cases of trouble have been reported on this item."

"How much has it cost?"

"The repair cards for a year back show that $400 has been spent on their repair and maintenance."

"Does any special make of truck show this trouble to excess?"

"The inspection reports show that one make of truck is more liable to this trouble than any other."

"Is it general over the country or limited to certain parts?"

"To a certain part."

"Can this be traced to a certain repair shop?"

"Yes, the repair cards show it."

"And so on. Let us take a special case and follow the checks and counterchecks that can be made on truck and maintenance.

Checks and Counterchecks

"Take the item of springs. The repair cards show an excessive expense. Is it a defect? Inspection reports show it is not general. Is it limited to one make of truck? No. Has any particular truck had excessive spring

trouble? Yes; No. 187. What do the inspection reports for the last year show? Eight cases of spring failure. Is it the fault of the driver? It seems likely, as he did not report any trouble prior to the regular inspections and moreover the inspection reports show that his truck did not appear to receive good attention. Or, it does not seem to be the fault of the driver, because he did report symptoms and these were not followed up by the inspector. Or, again, the performance section of the driver's cards show that his truck was habitually overloaded, through the fault of the office.

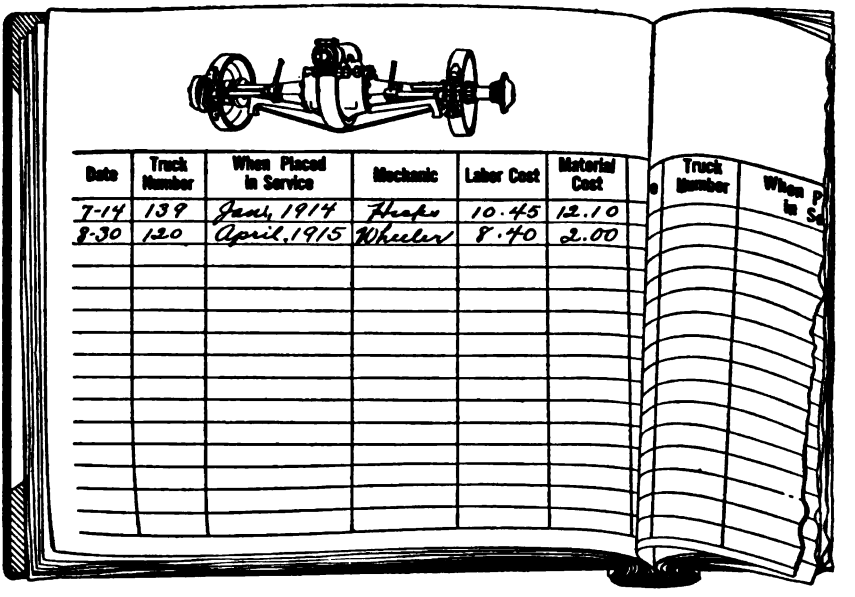


FIGURE 203: By dividing the motor truck up into systems or groups of mechanical parts as shown above and watching their performance, the superintendent can discover fundamental faults in certain makes and fundamental merits in others.

"Perhaps the trouble is in the repair shop. The repair cards show what mechanic performed the work in every case. If a great many repeat jobs can be charged to one mechanic, his work will bear looking into. If the same job requires two hours at one shop and four hours at another, the latter shop should be checked up. Perhaps the former shop has learned some new method which should be passed on to the others. The repair cards will show it.

"Again, the date when the truck was first put in service has a bearing on repairs. In time a truck depreciates so that its repairs are excessive. When is that time reached?

A Graphic Summary

"All these facts the supervisor learns as he turns the pages of his book. But the facts cannot be taken in at a glance, because they are not all on one page. How can they be presented on one sheet?

"A blueprint is drawn to cover one month. It is simplicity itself. On the left-hand side the various parts are listed. On the right are numbers representing trucks. It is reproduced in the first panel of Insert IV.

"Let us glance down the left-hand margin and see what we can learn. On September 1 and 2, no mechanical troubles were reported from zone four, which, we will assume, this chart covers. On September 3, item No. 53, service brake lining, gave trouble. On what truck? A line drawn across the blueprint leads to No. 49 on the right-hand margin. No. 49 identifies a certain truck.

"Going down through the month we find that on September 4, 6, 8, 12, 17, 20, 22, 23, 27 and 30 various mechanical troubles were reported and taken care of. On some of these dates more than one kind of trouble was encountered. Some of the troubles appear twice, three, or four times in the same month. But all of the troubles met with in one month for one zone are reported on one chart, by means of slender lines and compact figures.

"When so many facts covering so many trucks are assembled on one page, certain things stand out, which might be overlooked if the supervisor were compelled to dig through several pages of detailed reports. The supervisor, whose time is valuable, cannot wade through pages of detail, but requires a summary. Merely a glance at the summary is often enough to indicate to him three or four matters which would repay investigation.

"Let us work the thing out and show how the monthly chart indicates specific lines of investigation which, if followed up, may uncover important leaks or defects in the entire system of truck maintenance. I have drawn four sections of a sample chart, each of which indicates a general symptom of far-reaching significance. They are all graphically reproduced on Insert IV.

CASE I

"This shows an unusual condition at a glance. Part No. 42, case bearing supports, has given trouble four times during the month. Is it defective? Not likely, because it does not show up on any other truck in that territory. The investigation then proceeds along these lines:

"*First:* Is the driver at fault, in his operation of the truck, or in failure to report the trouble in time?

"*Second:* Is the inspector at fault, in failing to catch the trouble after a general symptom has been reported?

"*Third:* Did the same mechanic do the work in each case?

"This method of investigation takes shape instantly in the supervisor's mind, and his clerk chases through the driver's cards, repair cards and inspector's reports for a period of a month or more previous, until he has collected enough evidence to indicate the most likely cause of the trouble. The supervisor, with this material in hand, writes a letter to the foreman, which, by reason of the detailed knowledge it shows, may lead the latter to believe that a special trip has been made to investigate conditions. With two minds at work on the same problem, the cause of this unnecessary trouble is likely soon to be removed.

CASE II

"Case two is different. Trouble is reported on one part, but it is not confined to one truck. The drivers are ruled out. Is the part defective, or

poorly designed for the peculiar conditions of service? It seems likely. A glance at charts covering other zones will clinch the matter. If this examination shows that other zones do not experience this same trouble, the fault may be in the shop. Perhaps a certain mechanic is peculiarly unfitted to repair or adjust this part. The repair cards will throw light on this subject. And so the investigation proceeds until the ultimate cause of the trouble is found and removed.

CASES III, IV

"Case three shows general trouble, but confined to one truck. The chances are the driver is at fault, but he is not condemned until a thorough investigation eliminates all other causes. Perhaps the truck is too old for economical service. The inspection report gives that information.

"Case four indicates a remarkable freedom from mechanical troubles and the shop will warrant special attention to see if unusual methods have been developed by ingenious mechanics which other shops might well copy.

"The facts given in the monthly blueprints are assembled and presented in a yearly blueprint which gives a survey of the entire field of truck maintenance. The information is arranged with respect to items instead of dates. For instance, No. 41, case bearings, gave trouble thirty times in the entire fleet of over 600 trucks. Here is a fact of great importance, for it is based on experience so wide and covering such a long period of time that it expresses an average.

The Yearly Blueprint

"While the monthly blueprint is an aid to perfecting maintenance, the yearly blueprint is most valuable in shaping the policy of purchasing trucks. Certain makes of trucks show a higher cost of maintenance than others under the same conditions. Certain parts of *all* trucks show an unusual percentage of breakage under the peculiar conditions of carrying a plunging load of oil. Just as harnesses had to be redesigned and strengthened for horses hauling oil, so even standard trucks can be altered in certain parts to meet the test of peculiar conditions. Thus our yearly blueprint assisted me in solving these larger problems of selection and design of equipment which have had such an important bearing on our maintenance costs.

How Oils Affect Maintenance

"At first glance it is not obvious how keeping a record of oil used by each truck can be used to improve its maintenance. We will assume that, in the case of oil, everyone understands the necessity of adequate lubrication. Many believe that this has been taken care of, so long as the records show that the truck has been given enough oil.

"The matter goes deeper than that. It points directly to the condition of the engine. If one truck uses twice as much oil as another of similar capacity, the chances are that the pistons do not fit as they should. This means that too much oil is drawn past the cylinder walls. But it also means something worse—carbon deposited on the cylinder walls, which has an important bearing on maintenance.

"I have devised a form for keeping track of oil consumption, and the results are plotted on a form shown on Insert IV. Over an extended period of time

INSERT IV

this chart often shows up unusual variances in the consumption of oil. For instance, this is what I have found after making one of these analyses of oil consumption: Some of our trucks are operating at the rate of three, four, and five pints per thousand miles, which is an unusually low consumption. But when I find a truck using over 31 pints of oil per thousand miles, I want to know what the matter is. Let us see. This truck in question happened to be five years old; many of the parts are worn and consequently more oil is used. In another instance I have run down a leaky crank case. In still another case, severe haulage conditions are responsible.

"As a general thing, however, excessive consumption of oil generally points to worn or poorly fitting engines. Steps should be taken at once either to put the engine in good condition, if that is possible, or else supply it with a different grade of oil, one which, by reason of its greater body or viscosity will seal up the space between the loosely fitting parts and thus not only reduce the consumption of oil, and gasoline, but also make it possible for the engine to deliver a greater percentage of its power to the driving wheels.

"I have given you in bare outline my system of maintenance, based on an experience of many years in the motor truck field. I have come to the conclusion that rigid inspection is the price of truck longevity. It is the 'stitch in time that saves nine,' and in the same way a mechanical trouble which is 'caught before it has started,' will never develop into a serious ailment. The only way to detect these troubles is to inspect, and the only way to inspect is to formulate a system of questions intelligently designed, logical in their arrangement, and based on a schedule adapted to the needs of the installation. In some sections we have two trucks, in others twenty or thirty, and the entrie fleet is over 600. My system is designed to take care of the entire range of conditions, and I feel sure that any truck operator can adapt it to his own business with profit and success."

CHAPTER XIX

SAVING MONEY THROUGH PROPER LUBRICATION

TWO kinds of injuries may befall a motor truck: They are described as follows by an old garage mechanic who has torn trucks down to the chassis and built them up again for the last dozen years:

"In the first place, a truck can be speeded thirty or forty miles an hour, hit something and break an axle or a spring. Lots of excitement, lots of noise, but put in a new axle or a new spring, pay forty or fifty dollars, and the truck is as good as it ever was.

"On the other hand, try running a truck without oil. Not much noise or excitement there. The truck runs along, making a little more clatter than usual, until very soon the pistons get so hot they swell and grab hold of the cylinder walls and the truck stops. No crowd gathers around it, and yet ten times more destruction has been done than in the case of the accident.

"You take the machinery apart and what do you find? Nothing broken. But there's a piston scratched, and cylinder walls scored so that they will never be gas-tight again. There are bearings worn the hundredth of an inch, axle spindles, universal joints, steering gear all scratched and worn out of true. The transmission is damaged, and the worm gear drive which was polished down to the accuracy of a thousandth of an inch and designed to run in a perpetual bath of oil, is scarred and scored so that it will have to be reground and designed for a smaller truck.

"The depreciation of eight years has taken place in eight days."

The words of the mechanic are none too strong to describe the situation. They are echoed in more formal language by every important manufacturer.

Lubrication as Truck Makers See It. Here are the words of six truck manufacturers on the subject of lubrication:

Just how long and how profitably a truck will serve, depends more upon proper lubrication than upon any other feature of its care.

The proper lubrication of any mechanism is of such vital importance, and any neglect is so conducive to excessive repair bills, that the mechanic should

make it a *habit* to look after it daily without fail. It is easily understood and requires so little time when properly attended to that there is no excuse whatsoever for neglecting it.

Sufficient "oiling" is the first and final commandment of successful motor truck operation. Better too much oil than too little. Follow every instruction on proper oiling under penalty of punishment with big repair bills.

Lubrication of the truck is more important than any other thing in its care.

Inadequate lubrication may ruin *all* the working parts of the motor, as well as cause serious damage to other parts of the truck.

Lubrication is by far the most important art pertaining to the care and operation of trucks. Without lubrication, disastrous results are sure to follow.

We might go on down the list and quote other manufacturers. But the message is always the same. Lubrication is a life and death matter in the care of the motor truck. The business man will do well to heed the serious warnings of the truck manufacturers, and to see to it that proper lubrication is made the first commandment in his garage. It is a mere matter of damages. Accidents may cost hundreds of dollars, but improper lubrication may cost thousands—or as much as the truck is worth.

Steel Under the Microscope. In the preceding chapter we touched briefly on the subject of lubrication and showed why oil is necessary. A piece of polished steel as it lies in the hand, looks marvelously smooth. It can be made to have the luster of a mirror. You would never think that the burnished surface of the metal is composed of thousands of little jagged points that stick up like teeth on a saw. Yet this is just what the microscope tells, and it has been found impossible to polish even the finest steel so that it does not show these pits and craters under the lens of the magnifying glass. (Figures 204, 205, and 239.)

Think of the destruction that would be caused if two pieces of steel were allowed to rub together for any length of time. These thousands of little saw teeth would engage—lock with each other—rip and tear each other out, and blow away in the shape of fine dust. Imagine two steel files being rubbed together. That is what we would see if we had microscopes attached to our eyes. It would not take long for a piece of machinery whose parts were adjusted and fitted to a thousandth of an inch, to become "loose-jointed" and consequently worthless.

It is clear that something must be done to fill up these depressions and make the surfaces level which rub over each other. The first suggestion is to use water. Water is a lubricant; everyone knows how slippery a wet plank can be. But water "rolls

off," if there is any tilt to the surface on which it has been poured. Moreover, even if the surface is level, a very slight pressure will squeeze the film of water out.

Why Oil Lubricates. Try pouring oil on instead. You know how hard it is to remove a grease spot on the floor. The grease clings to the pores of the wood and you cannot remove it by ordinary means. In the same way oil flows into the depressions on the surface of polished steel and clings to it. It does not roll off, without leaving a thin film behind. And this film cannot be squeezed off by ordinary pressure. An oil film will, according to the viscosity or "body" of the oil, sustain a weight which may amount to several hundred pounds per square inch.

Oil then, not only fills up the minute depressions in the steel, but actually interposes a film between the rubbing surfaces. The parts of your engine, transmission, and so forth, if they are correctly lubricated, do not rub on each other, but on opposite sides of a film of oil. This film may be very thin, seldom more than 0.003 of an inch, but it is enough. Inasmuch as the steel surfaces do not touch, there is no friction between them. What friction exists is contained inside the film of oil itself. One side of the film rubs over the other. This does not cause much friction, because oil is a liquid. Moreover, analysis will show that oil is composed of molecules which are perfect globes. As a lubricant, therefore, oil has not only the advantage of being a liquid, but it is a liquid built up on the "ball-bearing" principle, which is the most efficient means known for reducing friction.

How to Select the Right Oil. While the average truck owner soon learns to appreciate the true necessity and value of lubricating oils, if he depends for his selection of them on the way they are advertised, he may be confused. In the advertisement he is led to believe that a certain name indicates certain secret and magic lubricating qualities contained in no other oil, qualities which are essential to prevent the ruin and destruction of his machinery. It may be that the same oils, or practically identical oils, are branded with different names by a refining company, in order to meet local conditions in various places or to make it appear that the name represents just what is needed for different mechanisms. Any other company may follow the same scheme, with the result that a certain kind of oil may be purchased under several different names. In some instances these may confuse the truck operator.

FIGURES 204 and 205: To the unaided eye a piece of polished steel presents a marvelously smooth surface. A microscope will, however, show thousands of little jagged points like teeth in a saw, which it is impossible to remove.

FIGURE 206: The trailer has solved the problem of hauling logs and has enabled the motor truck to displace the single-track forest railroad in many logging camps. One truck will "walk away" quite easily with a load a locomotive might not despise.

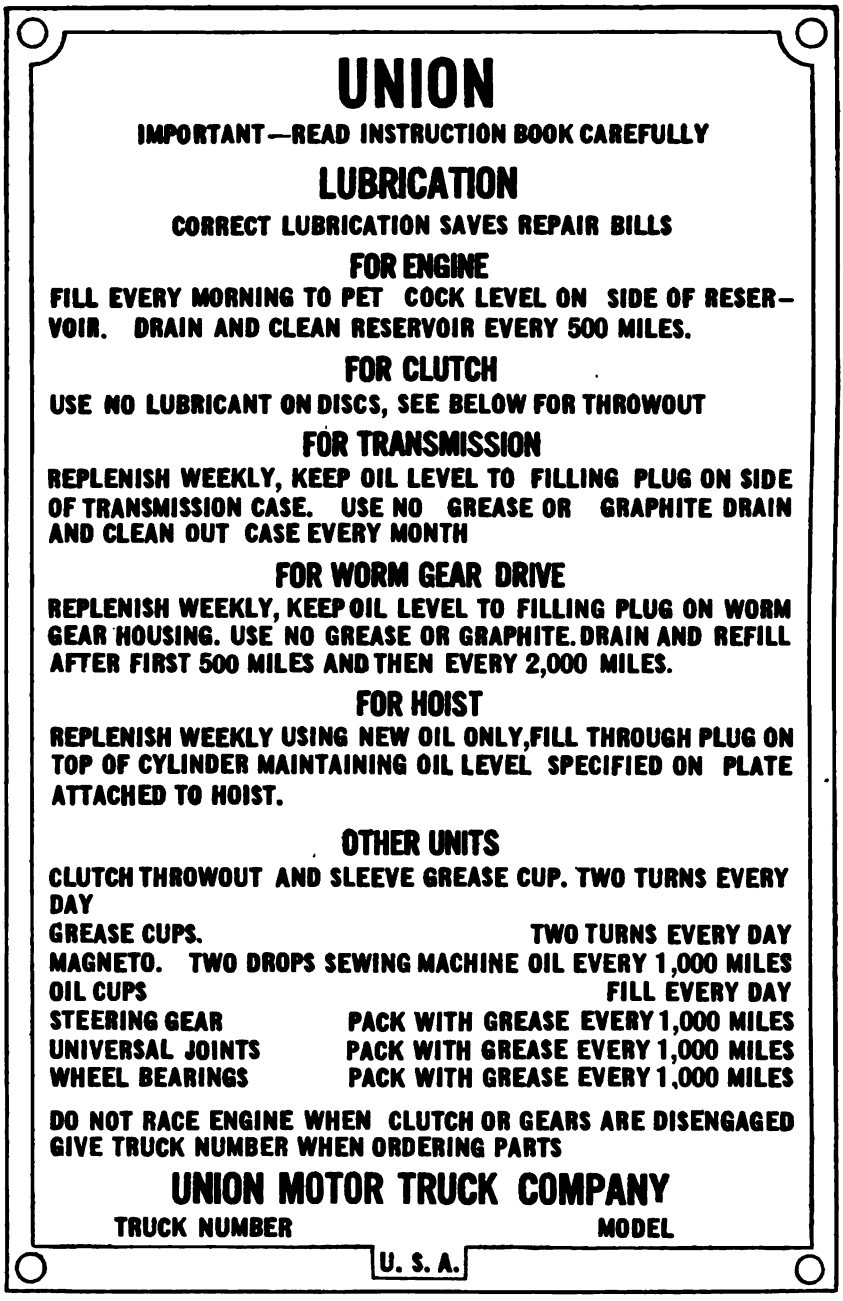

UNION
IMPORTANT—READ INSTRUCTION BOOK CAREFULLY
LUBRICATION
CORRECT LUBRICATION SAVES REPAIR BILLS
FOR ENGINE
FILL EVERY MORNING TO PET COCK LEVEL ON SIDE OF RESERVOIR. DRAIN AND CLEAN RESERVOIR EVERY 500 MILES.
FOR CLUTCH
USE NO LUBRICANT ON DISCS, SEE BELOW FOR THROWOUT
FOR TRANSMISSION
REPLENISH WEEKLY, KEEP OIL LEVEL TO FILLING PLUG ON SIDE OF TRANSMISSION CASE. USE NO GREASE OR GRAPHITE DRAIN AND CLEAN OUT CASE EVERY MONTH
FOR WORM GEAR DRIVE
REPLENISH WEEKLY, KEEP OIL LEVEL TO FILLING PLUG ON WORM GEAR HOUSING. USE NO GREASE OR GRAPHITE. DRAIN AND REFILL AFTER FIRST 500 MILES AND THEN EVERY 2,000 MILES.
FOR HOIST
REPLENISH WEEKLY USING NEW OIL ONLY, FILL THROUGH PLUG ON TOP OF CYLINDER MAINTAINING OIL LEVEL SPECIFIED ON PLATE ATTACHED TO HOIST.
OTHER UNITS
CLUTCH THROWOUT AND SLEEVE GREASE CUP. TWO TURNS EVERY DAY
GREASE CUPS. TWO TURNS EVERY DAY
MAGNETO. TWO DROPS SEWING MACHINE OIL EVERY 1,000 MILES
OIL CUPS FILL EVERY DAY
STEERING GEAR PACK WITH GREASE EVERY 1,000 MILES
UNIVERSAL JOINTS PACK WITH GREASE EVERY 1,000 MILES
WHEEL BEARINGS PACK WITH GREASE EVERY 1,000 MILES
DO NOT RACE ENGINE WHEN CLUTCH OR GEARS ARE DISENGAGED
GIVE TRUCK NUMBER WHEN ORDERING PARTS
UNION MOTOR TRUCK COMPANY
TRUCK NUMBER MODEL
U. S. A.

FIGURE 207: The truck operator need not want for guidance on the important question of lubrication. Nearly all manufacturers will furnish charts telling how, when, and where to oil their trucks. This chart, similar to one issued by one manufacturer, gives specific instructions which are simple and easy to follow.

The first rule for guidance in selecting oil is to ask the advice of the manufacturer of your truck. One maker furnishes an oil chart (Figure 207) with each truck. While such a chart may not be the last word on lubrication, it is likely that the advice given will be sound. For it must be realized that motor trucks differ considerably in their requirements for oil, and an oil program which might be suitable for one make of truck might fail to give good results in another. This is due to the construction of the truck. For instance, if your truck has a full force feed system of lubrication, you should use a heavier-bodied oil than otherwise. If the oil pipes are exposed to atmospheric temperatures, you must give special attention to the cold-test qualities of your lubricant. Other factors which influence the selection of oils are: the construction of the engine, bore and stroke, valve construction, number and fit of piston rings, piston clearance, cooling system, and engine speed. All these factors have a direct bearing on the oil which you should buy—with the emphasis not so much on the quality, which is assumed, as on the kind, the suitability, the specifications of the oil.

The manufacturer, who has built the truck, knows its peculiarities. The chances are that his engineers have experimented years ago with different kinds of oil and have selected the kinds which are most suitable for the truck in question. They have taken into consideration the peculiar design of the truck which demands peculiar qualities in oil. Oil can be mixed to specifications. Certain qualities which are desired can be accentuated, certain qualities which are not necessary can be dropped. The manufacturer has given thought to these matters. His advice should be eagerly sought, and followed unless there is good reason to believe that he is wrong. In case it is necessary to apply for claims under the guarantee, your position is stronger if you used the oils recommended by the manufacturer.

If the truck owner is unable to obtain or does not accept the advice of the manufacturer, he may establish his own specifications and tests for oils, based on what information he can get hold of. Here the average consumer stands in greatest danger of making a mistake, for he is grappling with a technical subject without being prepared himself to understand or follow the scientific reasoning on which it is based.

How the Government Will Assist. In this connection it is a surprising fact that so few American business men avail them-

selves of the assistance which the United States Government places at their disposal through such valuable and impartial institutions as the Bureau of Standards, a part of the Department of Commerce, in Washington, and the U. S. Naval Experiment Station at Annapolis, which is a division of the Bureau of Steam Engineering of the Navy Department in Washington, attached to the navy department. These institutions are constantly analyzing and testing materials of all kinds by means of the most approved and scientific apparatus, which the average business concern could not afford to purchase nor operate. The results of their investigations are at the disposal of those interested and may be obtained upon application at a nominal cost.

But if the business man does not avail himself of such sources of assistance, he must himself weigh the claims made by competing salesmen in respect to individual brands of oil and make his decisions independently. It is the habit of some salesmen to approach the truck owner with two or three samples of oil, and by means of tests performed in the presence of the buyer, convince him of the superiority of one sample over the other.

Now there are certain reliable tests and certain unreliable tests for oils. It is entirely possible that the salesman may be performing a sound test. The point is, however, the average truck owner does not know and has no means of knowing whether the test performed is true or false. Moreover, most tests do not indicate quality in the ordinary sense, but quality in the sense of characteristics, and even if an oil is proved by a test to have certain characteristics, it is still unproved that that oil is suitable for the truck in question.

Tests for Determining Purity of Oil. Plainly the wisest thing for the average truck operator to do is to eliminate from consideration all tests which are superfluous or misleading, and to confine his examination of oil to a few simple, standard experiments. Following are five simple tests for determining the quality of oils as given by an impartial authority, Lieutenant-Commander H. T. Winston of the U. S. Navy. Contracts covering over a million gallons of lubricating oils are being made each year by the navy department, and as result of experience in selecting and testing these oils the following tests are given:

A Good Oil—

1. Will not separate into layers of different shades or deposit sediment after standing a few days

2. Will not show rusting or corrosion of pieces of polished steel which have been suspended in it

3. When mixed with warm water and shaken in a bottle, will soon separate from the water and show no soapy emulsion

4. When tested with litmus paper, there will appear no acid contents

5. When cooled with ice the oil will not show a cloudy appearance, indicating waxy contents.

These tests require no elaborate apparatus, and can be performed by any business man in his office. They tell the *purity* of the oil—whether or not the refiner has done his work well and by means of dozens of successive processes has removed the paraffin, wax, asphalt, free carbon, and other impurities which exist in the crude, as well as the acids which are often used in drawing out these impurities.

Is the Oil Suitable for My Truck? If the oil passes these tests, the next step is to determine whether it is suitable for the use to which it is to be put. An oil may be pure, and yet not suitable for a given purpose. Thus, it may be so thin that it is "squeezed out" from between the bearings, or so thick that it will not flow between the surfaces of two finely adjusted parts; it may become sluggish upon being chilled, or burn up at too moderate a heat. Oil, in other words, has "specifications" which it must meet, different specifications for different jobs.

The following is a list of seven specifications often used to describe different grades of oil. Each specification has its meaning for the refiner or the chemist, but for the user the majority of them are unnecessary if not, in fact, misleading. We have starred those which require the special attention of the purchaser. Let him insist on those specifications being met, and he may be sure that the others will take care of themselves:

Specific Gravity, Color, Flash Point, Fire Point, *Cold Point, *Carbon, *Viscosity.

Another impartial expert, Lieutenant G. S. Bryan, U. S. N., points out the fallacies which the layman should avoid, and gives guidance for the interpretation and use of those specifications which should have a bearing on the proper selection of lubricating oils for motor trucks. They will enable the truck owner to post himself on this important question.

Specific Gravity—"This term means the weight of any substance as compared with the weight of an equal volume of pure water. The specific gravity is of no practical advantage to the consumer. The producer uses it to his

advantage in his refining. It might be used in conjunction with the flash point to determine what particular kind of crude a straight oil is made from, but it would take almost an expert to do this.

Color.—"Some oil companies, in their advertising, lay great stress on the color of their oils. The color of an oil has no relation to its lubricating value. About the only information of any value that can be obtained from noting the color, is whether or not it is a light oil compounded with a cylinder oil. If such is the case it shows the familiar greenish tinge of the cylinder oil.

Flash Point.—"The flash point of an oil is the temperature to which it must be heated in order that the vapors given off will give a slight explosion when a small flame is held immediately over the oil. It is important that the flash point shall be higher than the temperature of the inner surface of the cylinder. I do not know of any motor oils that have a flash point lower than 325° Fahrenheit. If the temperature of the cylinder walls gets up to this temperature in a water-cooled motor, there is something radically wrong. The remedy is not to get another oil of higher flash point, but to locate the trouble and remove it.

Fire Point.—"The fire point is the temperature to which the oil must be heated in order that it will take fire and continue burning when a flame is applied. Roughly it is about fifty degrees higher than the flash point.

"It is an old theory that was never founded on solid facts, that high flash and fire points are necessary in a motor oil or the oil will burn up without giving any lubrication. The point was overlooked that when we have a maximum temperature of the gases in the cylinder of 2,700° F. and an average temperature of 950° F., an oil with a flash point of 450° F. will offer but little more resistance to burning than one would of 350° F.

"Either oil will burn if kept for any length of time in contact with hot gas. Lubricating oil does not burn very easily or very fast, however, and the time given for it to burn in a motor cylinder is very short. A thin film of oil smeared on a hot (300°) piece of iron or steel will burn for several seconds if ignited. Few motors ever run at less than 120 revolutions per minute, and at this rate the average point of lubricated surface on the cylinder wall would be exposed to the action of the flame for only one quarter of a second. It is easily seen there is no danger of all the oil film being burned in that short time, though there is no doubt that some of it is burned, whether the flash point is 300° F. or 500° F. At high speeds the time allowed the oil to burn is so small a fraction of a second that we need not worry at all on this score. It would therefore appear that a flash point of 300° F. would be sufficiently high for almost any water-cooled motor.

Cold Point.—"The cold point, which is the temperature at which the oil freezes, should be sufficiently low to insure that no difficulty will be encountered at the temperature to which the crank case will be exposed. Otherwise, it is of little value. The heavy oils are usually the only ones that have cold points that are not sufficiently low.

Carbon.—"So much misinformation has been published on this subject that it will be well to look into the conditions resulting in its formation. In the first place, what is ordinarily known as carbon in the cylinders nearly always contains something else in greater or less quantity. Rust and small particles of iron are nearly always found.

"Some oils form a thick, viscous, gumming deposit, which retains the carbon formed on its surface and prevents it from being blown out through the exhaust. The best oil then, is not necessarily the one that will form the least carbon, but the one that will form the least carbon in the cylinder."

According to Lieutenant Bryan, oils made from asphalt base crudes have shown themselves to be much better adapted to motor cylinders, as far as their carbon forming proclivities are concerned, than are the paraffine base oils.

This brings us to the seventh and by all odds most important specification of oils, viscosity. Viscosity is the "body" of oil. It is that quality which enables the oil to remain in the shape of a film, even when exposed to high pressure, heat, or speed of moving parts. It is often described in terms of "heaviness" or "lightness," or resistance to flow, or even of thickness. Scientifically, it is measured by the time required for a certain amount of the oil to flow through a small standard orifice in an instrument called a viscosimeter. The vicosity can be judged roughly by noting the sluggishness with which an oil flows, and two samples can be compared in this respect by suddenly inverting sample bottles containing them and noting the comparative rapidity with which the entrapped air bubbles rise to the surface.

How Viscosity Affects Lubrication. For the cylinders of the engine an oil of medium or light "body" is generally specified. For the transmission and differential a heavy, almost sluggish oil is required. Let us see now what would be the effect of using transmission oil in the engine. Most truck engines are lubricated by the splash system—that is, the connecting rods dip into the oil in the crank case and splash or throw the oil into the cylinders where it quickly spreads into a thin film. If oil of too heavy a "body" or viscosity is used it will not spread quickly and evenly over the cylinder walls, but will "bunch," leaving parts of the cylinders unlubricated. Moreover, since the pistons work rather snugly in the cylinders, the heavy or viscous oil will not pass between the tight, swiftly moving surfaces, resulting in further lack of lubrication. Still another effect is loss of power, for the connecting rods, dipping thousands of times a minute into the pool of oil, must overcome the friction of passing through the oil itself, which in the case of a heavy viscous fluid is considerable.

Let us look at the problem now from the opposite side. Suppose we use light motor oil in the transmission. The light oil, flowing readily, quickly covers the gears. But the gears,

which bear upon each other with great pressure, since they are nothing but levers used to urge the truck onward, "squeeze out" the film of light oil almost entirely. The result is almost the same as if no oil were used at all.

The truck owner can show great skill in selecting oils of proper viscosities for different parts of his truck. The following fundamental principles will guide him in this matter:

Pressure.—It is important to select an oil that has body enough to prevent it from being squeezed out under the maximum load to which the bearing surfaces will be subjected.

Speed.—Where bearings work at high speed a thin oil should be used, for the film must flow and form quickly, and friction must be avoided.

Temperature.—Viscosity changes with temperature. Select an oil which shows a proper viscosity at the temperature at which it is to be used.

With special reference to the oil which is used in the motor cylinders, Lieutenant Bryan says:

"The deciding factor with regard to viscosity is the condition of the piston and rings. If they are tight, a light oil will give good results. If they are badly worn and loose, a heavy oil becomes necessary. If the oil is too light, too much of it will be drawn past the piston rings on the suction stroke. Likewise on the compression stroke some of the gaseous mixture from the carbureter will leak past the piston rings and condense in the crank case."

How to Regulate Lubrication. Not only must oil be used which is pure and which is suitable for the requirements of a given truck, but it must be used in proper quantities and renewed at proper intervals. How shall this be determined?

The best guidance comes from the truck manufacturer. Nearly all manufacturers will supply instructions for oiling their various models. These instructions for oiling are very explicit and generally mention by name every part of the mechanism which requires oil, stating the amount needed and how often the supply should be replenished. (Figure 208.)

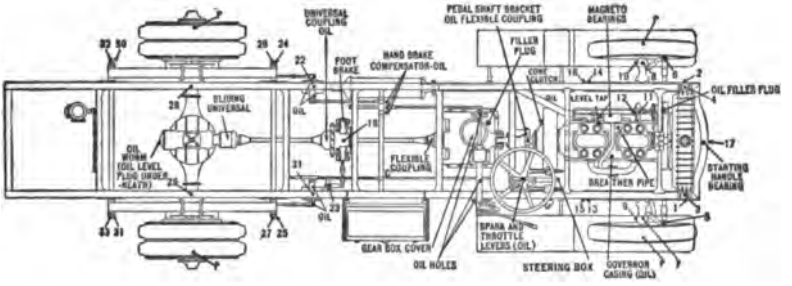
It is a good plan to tack up an oiling chart on the garage wall where it can be readily seen at all times. This will be a constant reminder to the driver or mechanic, and will also serve as a guide to the owner himself, by which he can personally check up the manner in which his trucks are being lubricated.

Better perhaps than the pictorial chart is the method employed by a Buffalo fleet owner. He has divided up the mechanism of his truck into six parts or systems, according to the kind of oil or grease which each requires and the frequency with which it should be supplied. This information is listed on one sheet called

When and Where to Lubricate

A Worm Drive Truck

(See complete directions for Lubrication, in Instruction Book)



There are 33 numbered Grease Cups on the Truck. These should be kept filled and turned down one full turn as follows:

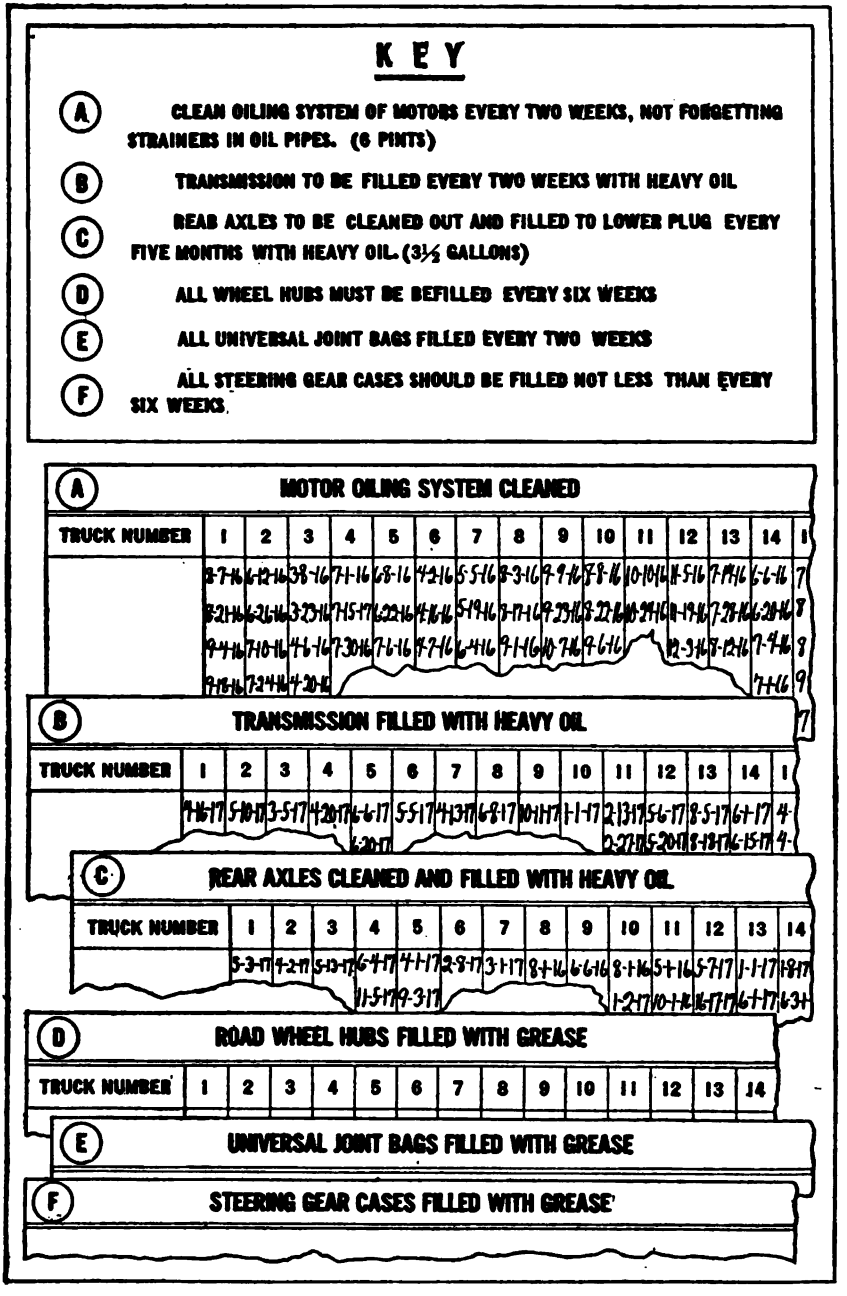
EVERY 100 MILES	EVERY 1000 MILES
Grease Cups 1, 2, 5 to 16, 21, 22, 24 to 33 should be turned down. The Engine Oil Level should be checked. Pour oil in through the breather pipe until it flows out of the upper oil level tap at the left side of the engine oil pan.	Oil Magneto Bearings, four or five drops engine oil. Grease Steering Box. Grease Ball and Socket Joints on the Steering Rod and Tie Rod. Oil Ball Thrust Bearing of Steering Column. Rear Axle, fill with oil to level of oil hole. Grease Wheels (P.F.P.P.) and pack Wheel Hubs in grease.
EVERY 200 MILES	**EVERY 2000 MILES**
Grease Cups 3, 4, 18 to 20, 23 should be turned down. The Hand Brake Compensating Mechanism should be oiled at the pins and points of wear.	Grease Cup 17 should be turned down. Oil Pedal Shaft Bearings, Oil Gear Lever Shaft Bearings. Fill Gear Box with Grease to top of standpipe. Oil Universal Coupling to mouth of housing. Repack Rear Sliding Universal Joint with grease.
EVERY 500 MILES	
The Starting Handle Bearing should be oiled.	

EVERY 3000 MILES	EVERY 4000 MILES
Repack Fan Bearings with grease.	Repack the Universal Couplings in front of and behind Gear Box with grease.

IMPORTANT

The Water Pump Grease Cups should be kept filled with beef or mutton tallow, or some grease not affected by water. The Engine should be hot when testing oil level and refilling. Chassis should stand on level ground.	The Clutch Leather should be touched up with pure castor oil whenever it shows signs of getting dry or glazing. Gravity of Gasoline should be approximately not lower than .745 or more than .703 at 60° F.

FIGURE 208: This chart makes lubrication a simple matter. Notice how it names every part of the truck chassis where oil or grease is needed, and specifies how often oil should be supplied to each part. Most manufacturers furnish charts such as this for their various models.


KEY
A CLEAN OILING SYSTEM OF MOTORS EVERY TWO WEEKS, NOT FORGETTING STRAINERS IN OIL PIPES. (6 PINTS)
B TRANSMISSION TO BE FILLED EVERY TWO WEEKS WITH HEAVY OIL
C REAR AXLES TO BE CLEANED OUT AND FILLED TO LOWER PLUG EVERY FIVE MONTHS WITH HEAVY OIL. (3½ GALLONS)
D ALL WHEEL HUBS MUST BE REFILLED EVERY SIX WEEKS
E ALL UNIVERSAL JOINT BAGS FILLED EVERY TWO WEEKS
F ALL STEERING GEAR CASES SHOULD BE FILLED NOT LESS THAN EVERY SIX WEEKS.
A MOTOR OILING SYSTEM CLEANED
TRUCK NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
B TRANSMISSION FILLED WITH HEAVY OIL
TRUCK NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
C REAR AXLES CLEANED AND FILLED WITH HEAVY OIL
TRUCK NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14
D ROAD WHEEL HUBS FILLED WITH GREASE
TRUCK NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14
E UNIVERSAL JOINT BAGS FILLED WITH GREASE
F STEERING GEAR CASES FILLED WITH GREASE

FIGURES 209 and 210: A Buffalo coal dealer makes lubrication automatic by means of these charts. At the top is the key chart from which the six ruled charts are developed. There is small chance of "forgetting" when a system like this one is used and small chance for excuses should any driver overlook any parts.

the "key lubrication sheet." (Figure 209.) Each of the six divisions is used as a title for a separate sheet, six in all, and the separate sheets are ruled in vertical columns, each column headed by an umber which identifies the truck in question. (Figure 210.)

How One Fleet Owner Regulates His Oiling. Let us take, for instance, the sheet headed "All wheel hubs must be refilled every six weeks." This is a matter which might easily be overlooked unless checks are put upon it. The check is the date of the last refilling. Thus, if the wheel hubs were refilled last on October 1, it is easy to see that around November 12 they will require refilling again. A glance at the chart tells the superintendent when this ought to be done, or whether it has been overlooked. It is a perpetual check on lubrication. There is the added advantage that if a driver or mechanic who has had charge of a certain truck quits, a new man can learn the state of lubrication of that truck and take up the work where it was left off.

Determining Oil Consumption. One operator makes use of his cost accounting system to give him a check on his oil consumption. Over a period of time oil consumption ought to be fairly regular, and show a relation to mileage run. This operator keeps a close record of oil and grease used and miles covered. In this way he is able to determine whether oil is used wastefully. On the other hand he has, by this method, caught a truck that was about to "go dry" because the driver failed to replenish the supply at the proper time.

Another user makes use of his cost system to determine the suitability of various brands of oil. He makes it a rule always to buy oil in sealed and branded containers. While there are scores of brands but only a few kinds of oils, one way to determine what oil to buy is to test out a given brand and during the test to allow no other to be used.

One user sums up the matter as follows:

"It is best to buy some well-known brand from a reputable refiner. First I determine whether the oil is pure, that is, well refined. Then I turn to the matter of viscosity. I use a lighter oil in winter than in summer. I use a heavier oil for worn parts or loose pistons. I select the right viscosity for the work the oil has to do. The rest I leave to the schedule. The oiling schedule is the first commandment in my garage."

CHAPTER XX

WHY OVERLOADING MEANS BIGGER REPAIR BILLS

THE motor truck of today is not a speculation, but an investment. The time has gone by when the truck was sold with extravagant but vague promises, and bought with mingled misgivings and hopes. More and more the motor truck is becoming understood, and is being assigned to its proper place in the field of transportation. It is neither a worker of miracles, nor an extravagant and unprofitable piece of machinery. It is a carrier with known possibilities, distinguished from the horse-drawn vehicle by its greater speed and power on the one hand, and its greater cost on the other. Under certain conditions it cannot economically replace the horse and wagon, but in most circumstances its greater speed and strength can be employed advantageously, so that a single truck may replace from three to ten, twenty, or even thirty horse units.

With the increasing knowledge of the truck as an efficient carrier, has come a better understanding of its limitations as a piece of machinery. When it is realized that a truck with proper care may last two, three, or ten times as long as one that is neglected or abused, it will be seen that truck maintenance is one of the most important factors in the whole problem of motor truck transportation. It is our purpose in the next few chapters to point out the more important abuses to which the motor truck is commonly subjected, and to show how, by avoiding them, its life may be lengthened and its value as an investment greatly increased.

Overloading, the Most Common Abuse. Perhaps the most common abuse to which the motor truck is subjected is that of overloading. It is hard to resist the temptation to "put on a little more" and get the same returns that another is securing from a more expensive investment. The truck will carry it—

it does not groan or cry out; and the power plant seems well able to move the overload at the same speed as a capacity cargo. Moreover, didn't the salesman say, "*Our* truck, although it's rated as a three-tonner, will walk away with five tons as easy as not. It has a big factor of safety!" (Figure 222.)

It ought to be a sufficient retort: "You can't get something for nothing." It may be pointed out that the factor of safety is for emergencies only, not for everyday use. It can be shown that well-known manufacturers design different models for different capacities, even though these capacities are separated from each other by only one-ton or even half-ton intervals, and that a truck designed for 4 tons, for instance, may cost $500 more than the 3-ton model, and a similar amount less than the next size above. The average person, however, is not satisfied by these general statements. He requires a more specific account of the matter. He wishes to know the reason why. And since good and sufficient reasons do exist, it ought to be possible to furnish them to the truck operator. He is really anxious to hear them.

Trucks are manufactured by concerns in competition with each other. In order to survive, a truck maker must design a truck that will deliver the most service for the money invested. This does not mean that the truck must be made as cheaply as possible. It means that strength and economy must be considered together. It will not do to build a truck that is enormously strong for the work intended, because such a truck would be unduly expensive, whereas a lighter truck, having a much smaller factor of safety, would handle the work just as satisfactorily and at much less expense. There comes a point where increasing the factor of safety does not pay—does not pay either the purchaser or the seller. Moreover, the designer must constantly work to keep down the weight of the chassis. This has been the constant effort of passenger car builders, and it holds true in greater measure for the truck maker. Extra weight means extra expense, both in selling price and operating cost.

What is Factor of Safety? The factor of safety in a motor truck, then, is large, but not boundless. It covers the maximum strains which a truck may encounter when used according to its rated schedule of speed and capacity, and provides a wide margin besides. It covers some of the abuses to which a truck is commonly subjected. It does not cover all.

It could not cover all. There are conditions and combinations of conditions under which a truck five times as strong as those built today would be smashed. The designer despairs of building a truck that will stand overloading and overspeeding over rough roads. It is apparent that such a truck would be monstrous in weight, and extravagant in price.

Moreover, the term "factor of safety" is often misinterpreted. It does not mean a zone of absolute safety. It does not mean that a member which is designed with a factor of safety of four will not break until a stress of four times the normal is exceeded. Such a member may fail at a stress of two, or again resist up to eight. Factor of safety is provided because of man's confessed ignorance as to the precise effect of various strains and shocks. Tests of materials result in an average only. Two bars of steel identical in size and apparently the same in stock may test, the one far above and the other far below the average for that kind of metal. Factor of safety is the best guess we can make to provide for these uncertainties.

Again, factor of safety is computed with reference to the breaking point. But metal can be injured long before the breaking point is reached. Metal is subject to fatigue, in much the same manner as animal tissue. It can be worn out internally before showing any signs of strain on its surface. Thus drawing on the factor of safety, when it does not result in immediate harm, is sure to cause a gradual and progressive damage which shortens the life of the metal by years. Moreover, it reduces the factor of safety. A piece of metal that originally had a factor of safety of six may, by repeated strains, be reduced to a factor of safety of four, then two, then one, then nothing. In that way a truck may fail with only a slight overload, or none at all, leaving the owner still to be convinced that there was no flaw in the metal.

Effects of Overload on the Axle. Let us consider some of the strains on specific parts of the truck which have a bearing on the factor of safety. One of the most important is the effect of overloading on axles. Figure 215 shows the nature and extent of the normal bending strain in an axle. In Figure 213 is an illustration of an axle spindle broken by overloading. The owner claimed that the spindle gave way when the truck was traveling along a smooth road with a capacity load. An examination of the damaged part showed that the metal was uniform, and contained no flaws. The appearance of the break

FIGURE 211: Rolling off a load of lumber in this case is the work of a minute. No need of a dump body or hoisting apparatus. The man at the crank turns a roller; the truck drives ahead a few feet and the load drops to the ground.

FIGURE 212: This contractor has equipped his semi-trailer with a dump body operated by a hoist connected with the engine. Note the large, steel-shod trailing wheels which carry about 60% of the load.

FIGURE 213: Most breaks in truck mechanism are the result of a succession of minor cleavages as in the case of this axle spindle which "held on" until its unbroken part was no wider than the granular band or zone shown in the picture.

FIGURE 214: Here is shown a rear view of the demountable body shown in Figure 183. A novel feature of this body is its removable top supported by short stakes which register with the stakes on the platform.

tells the story. There is a band or zone in the middle having the granular appearance of steel that has just been broken. Above and below this band the surface is smooth, almost polished. The case is plainly one of progressive fracture. The original fracture was either above or below the middle zone, or it may have been both above and below. A severe overload, coupled perhaps with momentary overspeeding, strained the outer fibers of the steel beyond their elastic limit. The owner did not know that the axle was damaged. The two surfaces of the fracture rubbed together. A second overload on some later trip widened the break, and further weakened the axle. Further strains spread the fracture. Still the axle held on. This is proved because the fracture existed long enough for the surfaces to wear perfectly smooth.

We know then that for some time the only thing which held the axle together was that narrow strip of metal in the middle. No better example of factor of safety could be desired. Finally, however, the inevitable happened. The factor of safety, having been reduced almost to one, gave way under only a normal strain. Overloading months before had weakened and finally ruined the axle.

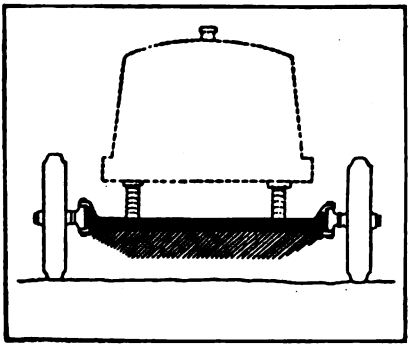


FIGURE 215

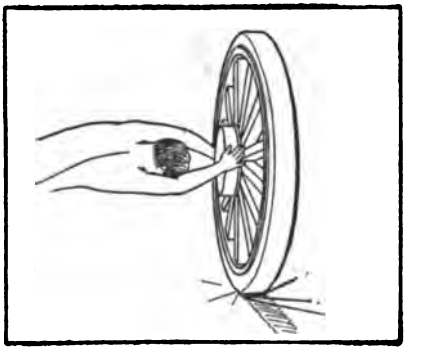


FIGURE 216

The Twisting Strain. Bending strains, however, are not the only kind of strains which bear increasingly on the axles from overloading. The torsional strain is very important. When the brakes are set firmly, the wheels and the rear axle become, as it were, one piece. The action of the road tends to cause the wheels to continue to revolve. The brakes, however, bind the wheels to the axle, and it is thus the axle which resists the turning of the wheels.

This is a tremendous strain on the axle, because the force of the road is applied at the rim of the wheel and has a lever arm as long as the distance from the rim to the hub, whereas the axle is much smaller and resists with a leverage only about one-fourth as great. A good driver, of course, will not apply his brakes so hard as to lock the wheels. Not all drivers are good drivers, however. Let us suppose that the driver does jam on the brakes and lock the wheels. Let us suppose that in addition the truck is heavily overloaded. The truck being overloaded possesses additional momentum, and being much heavier increases the friction or grip of the tires on the street. The torsion on the axle is enormous. It is double abuse, yet the engineer must design to take care of it and provide a factor of safety besides. (Figure 216.)

End Thrust on the Axle. There is still a third kind of axle strain which is increased by overloading. It is end thrust on the axle bearings. This occurs when the truck swerves from its straight path, and especially when it rounds a corner. Some hint of the magnitude of this force is felt by the passenger in the rear seat of a passenger car. (Figure 217.)

When rounding a corner briskly a person may be slid clear cross the seat and brought up sharply against the side of the car. The momentum of the body of a 150 pound man is, of course, nothing in comparison with the tremendous impulse with which a 5-ton load of merchandise plunges sidewise to the new direction of travel.

This is sometimes called the "skidding" strain. The term however, is inaccurate. It is the resistance against skidding which sets up the strain. Skidding is the safety valve, the mechanical way of showing that the strain is too great to be endured. When the tires finally slip and permit the truck to take a crab-like diagonal course, part sidewise and part straight ahead, it means that the tremendous momentum of the truck has triumphed over the grip of the heavy wheels which are trying to force it to take a new course, and that it is following, in a measure at least, the original course along which the great inertia of its momentum strives to carry it. As a matter of fact the degree of skidding often indicates that the strain is light instead of heavy, for, if the road surface is slippery, the wheels will not hold at all. But on a dry, roughened surface, the tires will hold true to their path, forcing the wheels and axles to take the full 100% of the side thrust.

The tendency of this strain is to push the axles through the hubs of the two outside wheels. In addition, there is a bending strain which tends to snap the spindle of the axle in two. Thus two strains are operating at once, the end thrust resisted by the bearings, and the bending strain resisted by the axle stock itself.

Effects of Overload on the Wheels. This end thrust acts with special violence upon the wheel. (Figure 218.) A wheel, whether of wood or steel, is tremendously strong in resisting

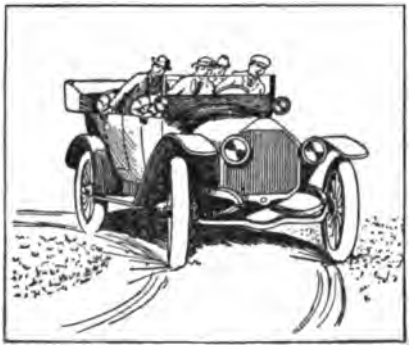


FIGURE 217

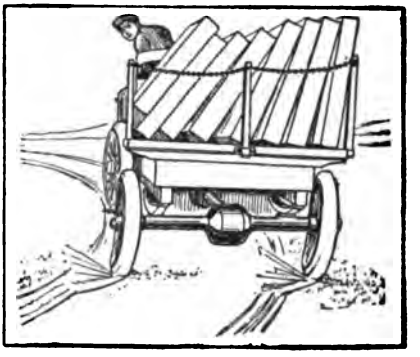


FIGURE 218

vertical strains. It has the enormous strength of an arch, and is further reinforced by its spokes, which not only support the arch but support each other. A test conducted on a 36 x 4″ dual wood wheel showed that it would bear a weight vertically of 114,000 pounds, or 57 tons. It is quite different, however, when a strain is imposed laterally at its rim. The wheel is not built to defend itself against pressure from that direction. Moreover, strains applied laterally at the rim act with great leverage against the hub, tending to "dish" the wheel even under normal conditions. Now, what happens when the truck is overloaded? Let us consider that the weight is doubled. It is the same as multiplying these enormous strains by two. Double weight means double momentum, and therefore double end thrust. Not only that, double weight means double wheel traction on the road, and double grip. The tires cannot slip or skid, the wheels cannot escape; they must meet the double strain. The two outside wheels with the axle spindles and bearings must take it all.

Effects of Overload on the Springs. Next, let us consider the effect of overloading on springs. This can be measured almost exactly by the extent to which it is practiced. In fact, while

certain other parts of a truck yield only to extraordinary strains, the springs suffer a gradual and progressive deterioration from any overload, and generally, in exact proportion to its duration and amount. This can best be understood by considering briefly the problem of the spring maker who must design and manufacture springs for a given load.

A truck spring utilizes the principle that relatively strong material will bend readily if made up in a long strip. This, of course, is due to the fact that bending stresses can be applied with enormous leverage in comparison with the resisting force which acts only through the thickness of the piece. A piece of hickory plank two inches thick and only two feet long is relatively stiff and hard to bend, but the same material fifteen or twenty feet long makes an excellent springboard. Moreover, a relatively long strip will bend through a long distance without seriously straining the fibers of the material. This is due to the fact that each unit of length contributes its deflection to the arc, making the total deflection at the extremities rather considerable. A short plank bent half an inch may suffer a more severe fiber strain than a long plank which bends several inches. The degree of fiber strain to which material is being subjected cannot be determined by the amount of absolute deflection, but by the amount of bend in comparison to its length and thickness.

Thin Objects Bend Easily. The fiber stress in material caused by bending can be illustrated by the behavior of men marching in a column which is turning a corner.

As the corner is being rounded the men on the inside shorten their steps while those on the outside lengthen their strides considerably. If the column is a narrow one, consisting of men marching three abreast, the difference in strides is not great, but if the column is very wide, having fifteen or twenty men marching side by side, the men on the inside become almost huddled together, while those on the outside are obliged to increase their strides to keep abreast on the turn. (Figure 219.)

The same thing, in terms of fibers instead of men, happens in material that is being bent. The fibers on the outside of the curve become stretched, those in the middle remain neutral, those on the inside become compressed. In a thin piece of material the fibers suffer a relatively small amount of stretching and compression in bending a given number of degrees. If the thickness is increased the fibers suffer greater distortion in

bending the same amount. A strip of quarter-inch steel may bend a certain distance a thousand times without breaking, while a piece of half-inch steel may snap on the first attempt.

FIGURE 219

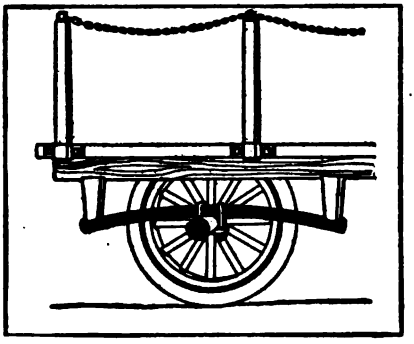


FIGURE 220

Deflection Measures Spring Action. Two more facts in this connection may be mentioned here. The ultimate object of the spring designer is to secure so many inches of spring deflection per thousand pounds carried. This is the measure and the only measure of the effect of spring action. A spring that deflects one inch under a thousand pounds, will deflect two inches under two thousand and three inches under three thousand pounds, and so on until the elastic limit is reached. The same is true of a bar of metal not designed in any way for use as a spring. Such a bar might be used in place of a carefully designed spring and give substantially the same results, but it would be heavy and very expensive and would probably fail early from fiber stress concentrated in two or three points instead of being distributed evenly along its entire length. (Figure 220.)

With the foregoing facts before us, let us consider how the spring designer is influenced and limited in building a spring. Let us suppose that he is designing a spring to carry, as its part of capacity load, a weight of 2,000 pounds. In springs for passenger cars a deflection of one inch per one hundred pounds is often figured on. If this were applied to the truck, the springs would deflect twenty inches under capacity load. Manifestly this would be excessive—not only would it cause undue fiber stress in the spring steel, but it would permit too much bounce or vertical motion in the chassis. The spring designer must cut the deflection under load to about one-fourth that amount, or nearly the same as with the passenger car. This does not mean

that the springs will act as easily as those on the passenger car, for although the total deflection under its load is about the same, it requires four times as much load to compress the stiffer truck spring, and road shocks will thus be resisted four times as much.

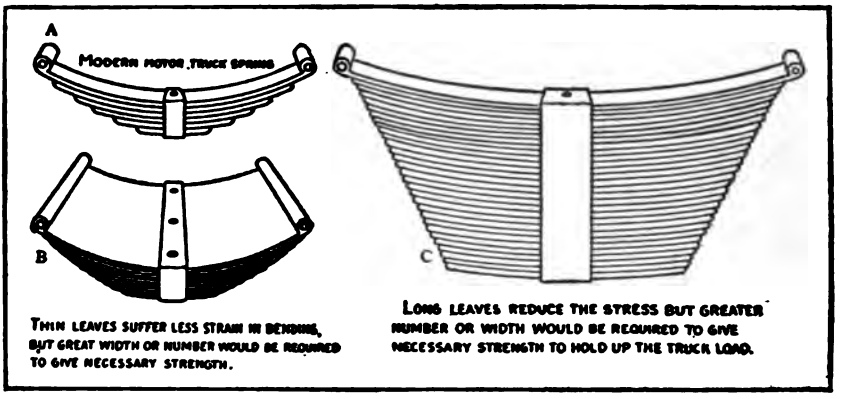

A
Modern motor truck spring
B
C
Thin leaves suffer less strain in bending, but great width or number would be required to give necessary strength.
Long leaves reduce the stress but greater number or width would be required to give necessary strength to hold up the truck load.

FIGURE 221: The ultimate object of the spring designer is to secure a certain spring deflection for each thousand pounds carried. This drawing will illustrate several of the problems he must contend with in designing motor truck springs.

Robbing Peter to Pay Paul. Having determined the proper deflection for the capacity load, how can the spring maker build a large factor of safety into his spring? It will not do to make the spring stronger, because that will make it stiffer, too. It is the business of a spring to be springy, and in the degree to which it ceases to be flexible, it ceases to protect the car. By making the spring stiff, so that under load it deflects only half as much as formerly, it is possible to make it last indefinitely. But the small amount gained in that way, is spent many times over in repairs to the mechanism of the truck. Thus, a good spring cannot always be recognized by its durability until it is ascertained whether or not the spring is really flexing with every movement of the truck or whether it is practically idle.

This, then, is the dilemma of the spring maker, and shows why in the best-designed springs the factor of safety must be comparatively small.

To anyone claiming that a certain truck is guaranteed to carry half as much again as its rated capacity, it is a proper retort to say:

"In that case the springs must be too stiff for the rated capacity and consequently they must resist unduly the jolts

and jars of the road, throwing greater strain on the axles, and transmitting a greater shock to the mechanism of the truck. If they are correctly designed for the rated capacity, however, then this added load must have the effect of causing a greater

FIGURE 222

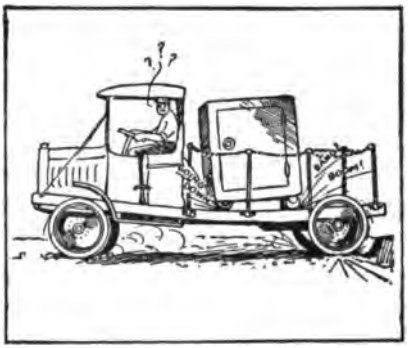


FIGURE 223

stretching and compressing of the fibers of the spring steel than was ever intended, and although this may not cause an immediate fracture, nevertheless it must be wearing out the fibers of the steel at an undue rate that may have the effect of shortening the life of my springs by half."

Effects of Overload on the Frame. The effects of overloading on the truck frame are not so serious as with springs. There is no such strict limitation on the factor of safety which may be built into a frame, and with modern pressed-steel construction, there are not many cases of frame fracture. Nevertheless, there are certain points in a frame which are particularly susceptible to undue strains. These are the holes bored through the beams of the frame for attaching the mechanism of the motor and transmission. In modern practice these holes are made as few as possible. They cannot be entirely avoided, however, and they do constitute points of weakness which are the first to give under exceptional stress. This weakness is guarded against by engineers by building the frame out of stronger material than would otherwise be required.

Let us suppose that a truck carrying a capacity load drives over a beam or curb having a drop of some five or six inches. Such a condition is found in every city; it is by no means rare. What happens to the frame? (Figure 223.) The load, which was previously static, is given a downward motion. It acquires

momentum, and forces the frame downward with great power. The springs must yield, for if they resisted such a force they would be too stiff to protect the truck against normal shocks. Finally, the frame is brought up against the bumpers, if there are any, or directly against the axles. Without estimating the effect of this blow on the axles, let us consider the stress on the frame. It is almost as if the whole weight of the load were dropped on it from a height of three or four inches. The stress mounts up immediately to four or five times that of the static load. It may break, or at least bend the frame.

Now suppose that the truck is carrying a load of twice its rated capacity. The shock is increased not by addition but by multiplication. The strain of five is multiplied by two, making the enormous product of ten times the normal stress on the frame. It would be useless to design a frame to resist such strains, since it would have to be excessively heavy.

Effects of Overload on the Tires. The effect of overloading on tires is very serious. The result, in fact, is so little understood, and has such an important bearing on tire expense, that we have treated it fully in Chapter XXII.

Effects of Overload on the Brakes. The effect of overloading on the brakes should also be considered. This is direct and proportional to the degree to which it is practiced. While the cargo of a truck does not bear down upon the brakes, it increases the momentum of the truck in proportion to its weight. The effects of momentum are seen in everyday life. An ocean liner, going at the rate of a few inches a second, may crush in a heavy pier if it strikes it head on. (Figure 224.) A long freight train, heavily loaded, often cannot be brought to rest within half a mile, but the same train, empty, can be stopped in less than half that distance. Icebergs, drifting slowly, can crush the strongest vessel.

This same force is present in the motion of the overloaded truck. The brakes must be applied with greatly increased pressure in order to bring the truck to rest in a given distance. The skilful driver, in such a case, will allow a longer time in which to bring his truck to a standstill, but the average driver is used to seeing his truck slowed down at a certain rate, and if ordinary pressure on the brakes will not accomplish this, he will apply extraordinary pressure. Moreover, in emergencies the truck must be stopped within a certain distance, regardless of its

momentum. There is nothing to do but to apply the brakes with grinding pressure, the effect of which is obvious.

Effects of Overload on the Transmission. The transmission does not escape the effect of overloading. As the load does not in any way rest upon the gears and shafts, it is not always easy to see how overloading can affect them. The answer is found in terms of the increased work which is put upon them. Obviously more effort is required to push a heavy wagon than

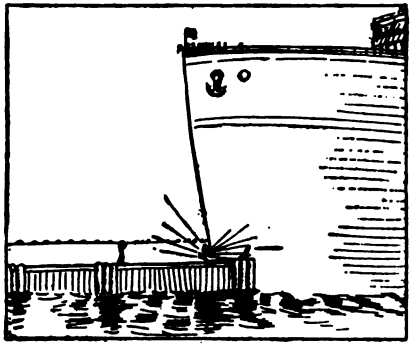


FIGURE 224

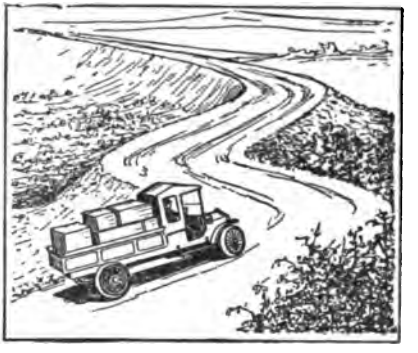


FIGURE 225

a light one. In an overloaded truck, the increased effort is transmitted by the various teeth of the gears of the transmission and differential. These teeth are in effect so many levers, each one of which transmits the turning power of the engine to the driving wheels. Now, it may be said that the strain on the transmission is limited by the maximum torque or turning power of the engine which is a fixed quantity and which is often reached without involving an overload, as when a truck with normal load is climbing a very steep grade. (Figure 225.) This is true, and the transmission of a truck is designed to withstand this maximum strain. However, under average conditions these maximum strains are by no means frequent, just as steep grades are also not frequent. If a truck did nothing but climb a continuous steep grade, thus utilizing the maximum turning power of the engine, the transmission would have to be much more expensively designed and built, and with even these precautions against strain, it would be impossible to prevent a greatly increased wear and tear. An overload has much the same effect as making the truck climb a continual hill. While as a general thing it does not impose a sudden stress which the transmission cannot with-

Weights Per Cubic Yard of Materials Commonly Hauled by Motor Trucks

STONE, BRICK, CEMENT, Etc.

Asphalt	2329
Brick, soft	2700
Brick, common	3024
Brick, hard	3375
Brick, pressed	3645
Brick, fire	3780-4050
Brickwork in mortar	2700
Brickwork in cement	3024
Cement, Rosendale	1620
Cement, Portland	2106
Clay	3240-4050
Concrete	3240-3780
Earth, loose	1944-2160
Earth, rammed	2430-2970
Glass	4212-4644
Gravel	2700-3240
Granite	4320-4590
Gypsum	3510-4050
Lime, quick	1350-1485
Limestone	4590-5400
Marble	4320-4860
Masonry	3780-4320
Mortar	2430-2700
Pitch	1944
Plaster of Paris	1998-2160
Quartz	4455
Sand	2430-2970
Sandstone	3780-4050
Slate	4590-4860
Stone (various)	3645-5400
Trap	4590-5400
Tile	2970-3240
Soapstone	4482-4725

WOOD

Ash	1215
Cedar	1063
Elm	1026
Hemlock	648
Hickory	1296
Mahogany	1377
Oak, Red	1242
Oak, live	1863
Oak, white	1296
Pine, white	756
Pine, yellow	1026
Poplar	810
Spruce	756
Walnut	972

METALS

Aluminum	4495
Brass	14470
Bronze	14900
Copper	14900
Iron, Cast	12150
Iron, Wrought	12960
Lead	19160
Steel	13220
Tin	12375
Zinc	11785

COAL AND COKE

Anthracite	1485-1782
Bituminous	1350-1485
Cumberland	1421
Cannel	1358
Charcoal (hardwood)	499
Charcoal (pine)	486
Coke	621-864

LIQUIDS

Water	1674
Gasoline	1188
Muriatic Acid	2025
Nitric Acid	2052
Sulphuric Acid	3105
Linseed Oil	1592
Petroleum	1485
Tar	1674
Vinegar	1809
Fuel Oil	1475

MILK

10 gallon cans	110
Case 12 qt. bottles	60
Case 20 pt. bottles	60

PRODUCE

Flour in barrels	220
Sugar in barrels	360
Sugar in ½ barrels	150

PIANOS

Unboxed	700-900

GRAIN

Wheat per bushel	60
Corn per bushel	56
Oats per bushel	30

FIGURE 226: This table contains a list of commodities commonly hauled by trucks and their weight in pounds per cubic yard. A comparison of these weights with the amount of space occupied by a load will tell whether the load exceeds the rated capacity of the truck. Perhaps your driver will be interested in these figures.

stand, since this is prevented by the known limitations of the engine which creates the stress, it does cause an increased wear and tear of all gears, and shortens their life.

Again the truck driver complicates the question. He is accustomed to seeing the truck perform at a certain speed on a given grade, and selects his gears accordingly. But the overloaded truck will lag behind this performance, and a gear ratio which would carry along a normally loaded truck will just fall short of sufficing for the overloaded vehicle. The driver, shifting his gears by instinct, will continually "crowd" the truck, using the gear ratio to which he is accustomed for a certain work.

Effects of Overload on the Engine. Finally, the effect of overloading on the engine is much like that on the transmission. When too great a strain is placed upon the engine, it defends itself by ceasing to work altogether. While the engine resists being put to extraordinary exertions by going on a strike, it will submit to a wide range of tasks without complaining. However, additional effort is obtained only at the price of additional wear and tear. There is additional strain on the crank shaft and the connecting rods, the gas explosions are more violent, the engine is frequently run at a greater speed than would otherwise be required, and often the cooling surface of the radiator does not suffice for an increased and sustained demand, resulting in serious damage to the engine.

The table shown in Figure 226 contains a list of the weight per cubic yard of the materials commonly hauled on motor trucks. A comparison of these weights with the amount of space occupied by any given load will enable the truck operator to gage whether or not his load exceeds the rated capacity of the truck.

CHAPTER XXI

HOW TO CURB OVERSPEEDING AND OTHER ABUSES

HAND in hand with overloading is overspeeding, an abuse as common and perhaps fully as disastrous to truck longevity. Overloading causes a strain, but overspeeding introduces a jolt. Overloading breaks down, but overspeeding smashes to pieces. While each abuse has its peculiar effect, and each alone is capable of ruining a truck, they often are seen together, and here they are irresistible.

What is Speed? At the outset we are faced by this physical fact—that the energy of a moving body varies as the square of velocity. Double the speed of a projectile and its capacity for delivering a blow is multiplied by four. Triple the speed, and

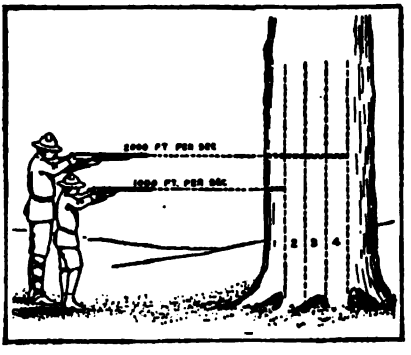


FIGURE 227

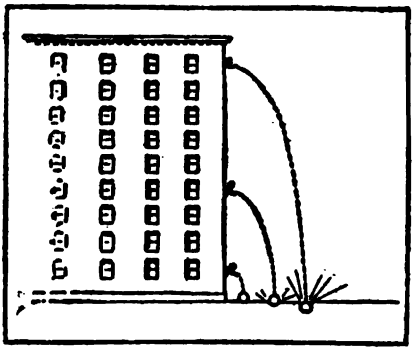


FIGURE 228

the energy is increased nine times. If one bullet has twice the speed of another bullet of similar shape and weight, it will penetrate a target four times as deeply. (Figure 227.) If you drop a weight out of a first-story window it will develop a certain velocity in its fall, but you will have to carry it up three more stories and drop it out of the fourth-story window in order to

give it twice the velocity at the time it strikes the ground. If an object falls from a ninth-story window it will be traveling when it strikes the ground at a rate of speed only three times as great as if it fell from the first story, but the blow will be nine times as violent. (Figure 228.) And, similarly, if the speed of a truck is increased from ten to thirty miles an hour, each irregularity in the road will strike a blow nine times more violent.

High Speed not Always Desirable. Engineering problems which are simple when low speed is involved, become enormously difficult when an increased velocity must be reckoned with. This is the reason why railroad trains running at eighty or ninety miles an hour have not proved a practical success. At such enormous speeds the slightest irregularity in the rails, or the wheels of the locomotive, or any of the wheels of any of the coaches, strikes a sledge-hammer blow which is destructive of the strongest construction in train or road bed.

Some years ago a certain railroad put into effect on part of its system a train service involving a speed of ninety miles an hour. They experienced some trouble with broken rails and weakened road bed. This was finally traced down to one locomotive, and it was found upon closer examination that one of the driving wheels was off center by one-eighth of an inch, so that the whole wheel had an eccentric motion, being slightly low during one-quarter of its revolution and slightly high during the opposite quarter. If this irregularity were to be expressed graphically it would be represented by a line so nearly level that the eye could hardly discern the gradual sag in it.

At moderate speed it would have caused no trouble. At the speed of ninety miles an hour, however, this irregularity was passed over in a small fraction of a second, and delivered a sledge hammer blow to the rail, and back again through the locomotive. (Figure 230.)

While the motor truck has an advantage over the locomotive in that its wheels are shod with rubber which absorbs small shocks and deadens larger ones, it is at a much greater disadvantage with respect to the road surface over which it travels. In comparison with the steel rail the average road is literally a series of hills and valleys. (Figure 229.)

Let us consider what happens when a truck strikes a road bump when traveling at twenty miles an hour. We will take for example an irregularity measuring roughly six inches on its

slope and three inches in perpendicular height. At twenty miles an hour the truck wheel will pass from level ground to the summit of the bump in one forty-fourth part of a second. The wheel and axle are thrown upward at a velocity of nearly ten feet per second. This, however, is a gentle rise in comparison with that shown at the right of Figure 231. Here the elevation of the wheel and axle is almost instantaneous, and the force of the blow is very much greater.

Speed and the Direction of the Blow. Not only does increase of speed greatly increase the violence of the road shocks, but it changes their direction. A wheel passing slowly over an

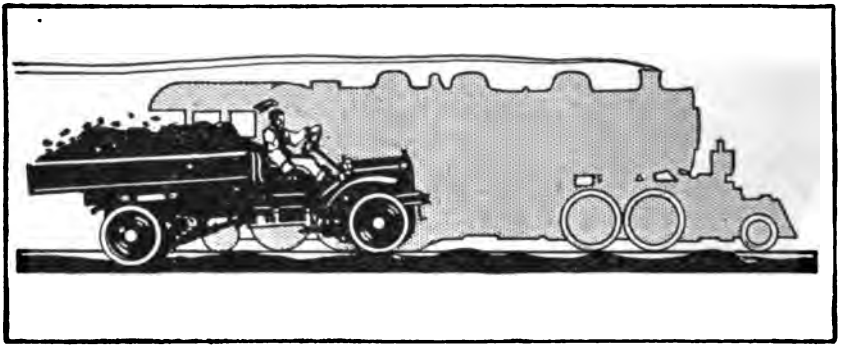


FIGURE 229: Like hills and valleys—that's what the average road looks like in comparison with the steel rail. That's why speed ruins trucks. No doubt your driver will be impressed by this explanation of the destructiveness of overspeeding.

elevation delivers and receives a shock in very nearly a vertical direction, for the forward motion of the vehicle is small in comparison with its weight, which acts downward. As the speed is increased the truck wheel in addition to bearing down on road obstacles, strikes a horizontal blow at them, so that the reaction of the road thrusts backward in a diagonal direction through the wheel and springs. Such a shock instead of meeting the full cushioning effect of the springs, passes to some degree lengthwise through them and strikes a dead blow on the axles and truck mechanism as illustrated in Figure 235.

Speed and the Inertia of Matter. While increasing speed greatly increases the force of blows from road irregularities, it has another effect which it seems impossible to guard against by ordinary measures. This is the effect of suddenness of shock, due to the inertia of matter.

A few homely examples will serve to illustrate this fact. A door standing ajar on well-oiled hinges can be pushed to by a gentle shove, but if you hit it a sharp blow with your fist the door will remain practically motionless while your knuckles will be severely bruised. If a rod is laid upon a desk so that part of it overhangs, and is struck a sharp blow on its projecting end, it will bend and perhaps break, even though very gentle pressure at the same point would have been sufficient to lift the heavier end. (Figure 232.)

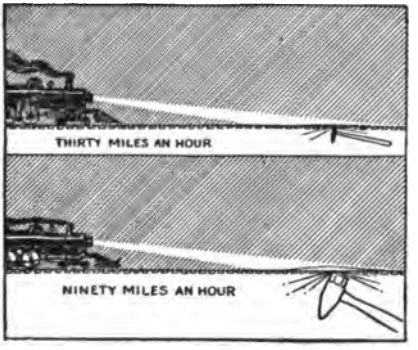


FIGURE 230

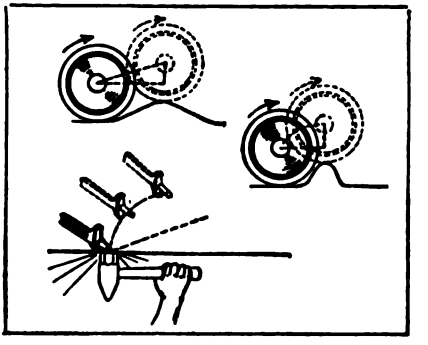


FIGURE 231

The force is applied so suddenly that there is not time for it to act throughout the whole mass of the object.

The axle of a truck may be aptly compared to the rod. That part of the axle to which the wheel is attached may be compared to the projecting end of the rod, since it is at that point that the blow is delivered. The rest of the axle corresponds to that part of the rod lying on the desk, because it is comparatively free to move, being held down by flexible springs which yield readily to gradual pressure. Going at moderate speed the wheel rises and falls, taking the whole axle with it, but if excessive speed is practiced a blow may come so fast that there is not time to distribute it along the axle and through the spring.

The axle suffers a sudden strain, and if it has been weakened by repeated strains, may even snap off, precisely as the rod in the experiment. This point is illustrated by Figure 233.

It may seem strange to the average person to learn that this same thing is true of so responsive a device as a steel spring. We know that there is an enormous amount of energy in a hammer blow, because we can drive a nail with a few sharp taps of a hammer whereas a man may bear with all his weight on the same

nail without making it enter the wood a particle. Tests by spring manufacturers, however, show that a sharp or sudden blow with a hammer on a spring produces practically no deflection.

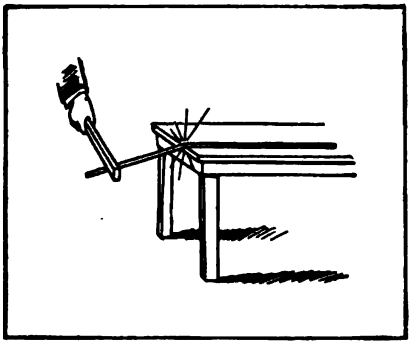


FIGURE 232

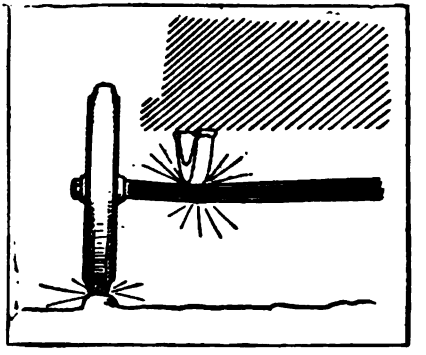


FIGURE 233

How Speed Affects Vibration. From this we may discover the reason for the most destructive effect of speed—namely, vibration. Anyone who has ridden in a truck knows that when the speed is increased the vibration becomes very severe. This is due not only to the greater violence of the road shocks, but to the fact that the truck springs and in fact, all parts of the truck cannot absorb the blows as fast as they are delivered, but receive them rigidly and transmit them unsoftened to neighboring members.

There is no question that vibration is the most serious agent of ruin to which the motor truck is subject. It is a multiplication of the dreaded hammer blow, the most destructive force which can attack machinery. It begins at the axles and fills them with fatigue, which acts upon them much as a disease. It attacks the springs, which are tuned for heavier and slower shocks. It climbs through the springs into the mechanism of the truck and there it works its worst havoc. It attacks every moving part. It seizes with special delight on loose parts, because looseness means play, and play means room to swing the hammer and greatly increase the hammer blow. It is everywhere. It is pervasive as rust. It skips nothing, but brings about a general deterioration in every piece of metal. And it is caused by speed —blows that come too fast for the truck to absorb. Thus a truck driver who constantly overspeeds his truck, even though he does it so skilfully as to avoid direct breaking strains, cannot

escape the consequence, for he is bringing about a general deterioration, a premature old age of all the parts, so that the time may soon come when it is possible to say: "Last month the truck worked all right; today it is beyond repair."

It is here that the rubber tire performs a valuable service. Unlike the spring, which must yield in every fiber of its several leaves throughout their three or more feet of length before it can be said to have responded to a blow, the rubber tire receives the whole shock in a comparatively small section scarcely larger in area than that of the road hump which causes it. The experiment with the spring when tried with a solid tire, produces far different results. It is impossible to strike a tire with such a rapid blow that there is not time for its fibers to yield and respond to it. Therefore, as truck springs cannot be modified from their present design, extra cushioning must begin and end with the tire, in which a wide range of shock-absorbing qualities may be obtained according to the resilience of the rubber and the depth of cushion.

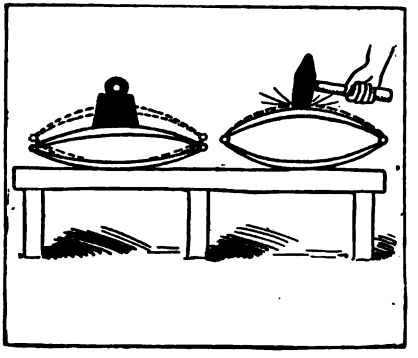


FIGURE 234

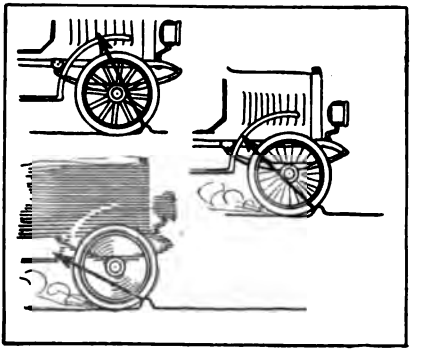


FIGURE 235

Speed May Upset Careful Calculation. This discussion may serve to give some hint of the many variables which enter into the problem of truck design when the factor of speed is introduced. Truck manufacturers have made the point that a truck correctly designed for use in New York or California might be entirely too weak for service in parts of Colorado or New Mexico. This is due not to the factor of load but to the factor of speed. A speed of ten miles an hour might be considered slow on some roads, and might be reckless overspeeding on others. A speed of double or triple the normal might be practiced with safety on a boulevard, while a speed of five miles an hour on an

uneven road surface in connection with an overload might wreck the truck. If the tires are allowed to wear down so that there is very little depth of cushion between the wheel and the road, a speed of six miles an hour may cause more serious shocks to the vehicle than a speed of twelve miles an hour on new tires.

Truck Designing a Difficult Problem. The problem of the motor truck engineer is immensely difficult. The bridge builder

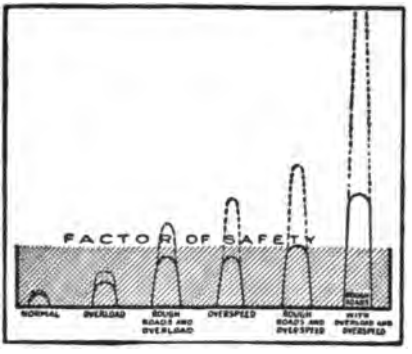


FIGURE 236

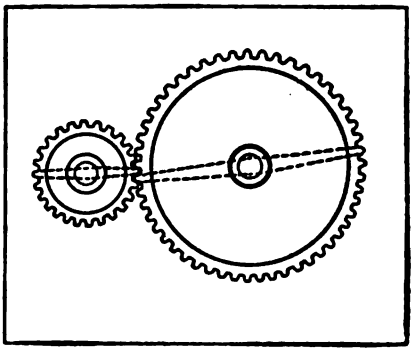


FIGURE 237

knows his maximum load; the locomotive designer reckons with smooth rails and a definite speed; the erector of skyscrapers has his weight and wind strains within reasonably certain bounds. But the motor truck builder stands with reference to his problem as a man surrounded by mountain peaks, some of which pierce the clouds. (Figure 236.) The motor truck, equipped with solid tires and relatively stiff springs, traveling over the roads of the present may encounter strains ranging from the normal to ten, twenty, or even thirty times the normal. A truck can be smashed to bits in a stretch of road only twice its length. The terrific impact which strikes it under certain conditions can only be compared to the force of a projectile.

Errors in Driving. Besides overloading and overspeeding, there is another important cause of truck breakdown. This is bad driving, especially with reference to the selection of gears and management of the clutch. The principles underlying gear selection are rather widely understood because of familiarity with passenger car practice in this respect. Most truck manufacturers publish excellent instruction books on this subject, which are available upon the request of the truck owner. They will be found of much assistance in training drivers.

These strains can be largely avoided by avoiding overload, which breaks a truck down and overspeed which smashes it to pieces. Both are harmful, both cause strains which test severely the factor of safety of the truck, but taken together they represent more than a severe strain, they constitute an accident.

Mechanical Means for Controlling Speed. The bad results of excessive speeding are so obvious that it is hard to understand how anyone who has had the matter explained to him can continue to subject his truck to such abuse. But some drivers will overspeed, in spite of anything the owner may say to them. The question, therefore, arises—cannot the speed of the truck be controlled by some mechanical device which can be regulated and sealed by the owner?

The speed governor is the best answer yet given to this question. Various devices have been made to control the speed of motor trucks, and most of them operate by automatically reducing the flow of gasoline vapor through the intake manifold, when certain speeds have been attained.

But the problem has not been an easy one to solve. The task is, briefly, to control excessive speed without interfering with that surplus power which the truck requires to negotiate difficult conditions of road and grade. With the early makes of speed governors, it was not difficult for an ingenious driver to "spike" the mechanism and put it out of operation temporarily without breaking the seal. This has now been largely overcome, and one manufacturer of governors has so perfected it that 57 truck manufacturers furnish it as standard equipment.

The Function of the Gears. The function of the change-speed gears is that of levers, used to multiply the power of the engine. The engine is an infant with respect to the load which it must move, and is no more capable of starting a heavy truck under its own power than a boy is capable of moving a freight car. A boy, however, by means of a long lever, can start the car in motion and after it is in motion he can use a shorter lever and finally dispense with levers altogether, keeping the heavy freight car moving by his own exertions unaided by mechanical power.

Gears are levers made in circular form for the sake of compactness as explained by Figure 237.

Proper selection of gears consists in choosing the right leverage for the work in hand. The skilful driver knows by the behavior

of the engine whether or not he has selected the proper levers for the task. On the other hand, more than one driver has attempted to start his truck on high-speed gear.

Management of the Clutch. Inseparably bound to this problem is the proper management of the clutch. Let us return to the example of the boy and the freight car. (Figure 238.) If the boy selects a lever too short to move the car he may

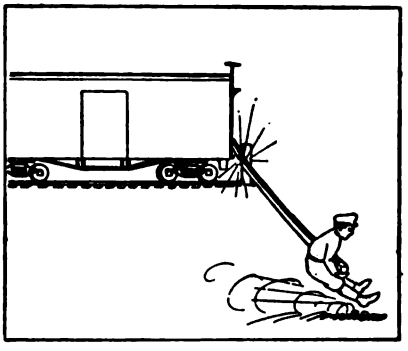


FIGURE 238

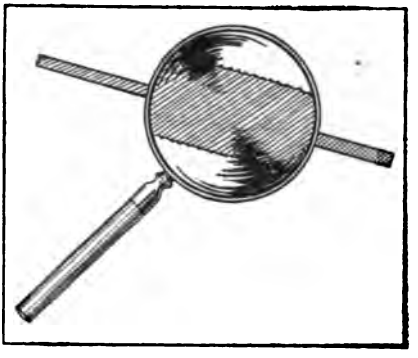


FIGURE 239

struggle with it indefinitely without results. If, however, he runs a few yards and hurls his weight against the lever, two things may happen—the car may start forward with a lurch, or —the lever may break. The engine of the truck may be compared to the boy who gets up momentum by running and then throws his weight against the lever.

It is the management of the clutch which determines whether this strain shall be sudden or gradual. If the clutch is thrown in sharply the full momentum of the engine with its heavy fly-wheel is brought up suddenly against the lever or train of levers in the transmission. Even when these levers or gears are set in their proper ratio the impact of the engine is so sudden that there is scarcely time for them to act. The engine stalls, or the clutch finally slips, but in the meantime the gear teeth are strained, but not so severely as the driving shaft, which is subjected to an enormous torsional stress, as is also the crank shaft of the engine. These strains are even more severe if the wrong gears are in mesh. The more serious fault, however, is the sudden engagement of the clutch, which does not allow time for the engine to stall before the impact of its momentum takes full effect on the transmission. This is the crux of the driving problem.

It is possible for an unskilful driver to wreck the driving mechanism of a truck in a single forenoon. On the other hand, proper management of the clutch and proper selection of the gears prolong the life of the truck almost indefinitely.

Lubrication. Another abuse to which trucks are frequently subjected is improper lubrication. It is possible to burn out a truck in ten minutes' time by running it without oil. Steel, however polished and smooth to the eye and touch, has in reality a rough surface. Under the microscope it shows a jagged outline. (Figure 239.) If two pieces of steel are rubbed together, the minute edges engage and tear each other, and as they are destroyed new edges appear, so that the process of destruction goes on rapidly and without interruption. Oil fills up these microscopic depressions and further places a film between rubbing surfaces which actually prevents them from "coming into contact." This subject, however, has been treated fully in Chapter XIX.

CHAPTER XXII

HOW TIRES CAN RAISE OR LOWER THE COST OF UPKEEP

IT has often been said that the tires constitute the largest single item of expense in the operation of the motor truck. This is true for two reasons, for not only are tires expensive in themselves, but they often have an important influence on the upkeep and performance of the truck—the work it will do per dollar expended. Much depends therefore on the proper selection of tire equipment, and its care after it has been selected.

Let us start at the beginning and consider the function of tires. This function is threefold:

1. To give traction to the wheels and prevent slipping.
2. To protect the mechanism of the truck from jars and vibration.
3. To cushion the load.

Why is it necessary to use rubber for this purpose? Rubber wears out, is subject to cuts and injuries, and when it is overloaded, overspeeded, or abused, often disintegrates and goes to pieces. Why use such a substance as rubber, which is comparatively expensive in first cost, and also expensive to maintain?

Is There a Substitute for Rubber Tires? This question was asked long ago, and men have been trying for years to discover a cheaper but satisfactory substitute. Steel tires were found to be durable, but they failed in all three of the essential qualities of a truck tire. They failed to give traction, they transmitted vibration to the mechanism of the truck, and they did not cushion the load. Wood blocks and wood fiber were tried, but this material was not much more resilient than steel and not nearly as durable. Such tires slipped on smooth or wet pavements and failed to provide the necessary traction. Cotton fabric, highly compressed, was given a trial, and while this material was fairly resilient, it lacked tractive grip and hence was useless on a vehicle which propels itself by power

delivered at the rims of its wheels. Finally, air was used as a cushion, imprisoned beneath a steel tire. This construction provided resilience at slow speeds, but at high speeds the inertia of the rim prevented the tire from acting quickly enough to absorb the road shocks and it also failed to give traction.

So, in answer to the question: "Why use rubber?" we must reply: "For lack of anything better."

What is Rubber? What is this substance which gives tractive grip to the driving wheels of the most powerful truck, and at the same time protects its mechanism from vibration and cushions its load? A better understanding of rubber will give the truck owner a better understanding of his tires.

You have seen maple syrup drawn from the trunk of a maple tree. In much the same way a thick sap is drawn from the trunks of various trees which grow in the forests of South America and Africa, and the East Indian Islands. This sap, however, is milky white, and after becoming exposed to the air, it thickens and becomes semisolid. It is pure rubber.

It is said that Christopher Columbus discovered natives on the island of Haiti who had in their possession lumps of this crude rubber. Certain it is that this substance has been known for centuries. But it seemed to have no practical use, for it was plastic and could be pulled out into any shape, like clay. For years, its only use was in rubbing out crayon marks, and from this it got its name—*rubber*.

The Discovery of Commercial Rubber. By accident, in 1839, Charles Goodyear discovered that by mixing sulphur with rubber and subjecting the combination to heat, a new product was made, a rubber which, while still resilient, was no longer plastic, but elastic instead. He had discovered the secret of vulcanization, which has given us one of those rarest of combinations in the same article—softness and strength.

While Goodyear's discovery was the important one, later improvements have served to refine the product and adapt it to various conditions of service. Thus, rubber used in a fountain pen must be hard and not resilient; rubber used in heels must be resilient but not hard; rubber in a tire must be resilient but at the same time tough and wear resisting; rubber used in a door mat need not be specially resilient, and while it must be wear-resisting, need not have the extreme toughness of rubber in tires which must stand up under severe strains and abrasions.

How Rubber is Compounded. There are a thousand and one different uses for rubber goods, which call for various qualities in the finished product. These qualities are produced according to the amount of sulphur used and also by mixing various substances with the pure rubber before it is vulcanized or "cooked," such as zinc, lead, asphalt, tar, and others. This is called compounding, and is the real secret of success in making tires or any other kinds of rubber goods, for while anybody can buy crude rubber, it requires the utmost skill and experience to compound it so that it is suitable for commercial use.

The development of tires, or any rubber goods, involves three steps. The first and most important is that of compounding which we have just explained. Next after the rubber has been mixed with other ingredients in correct proportions, the article must be fashioned or made, and here skill, experience, and equipment are important factors. The third and last step is the vulcanization—the "cure" as it is called by rubber manufacturers. This is the application of heat to the compounded and molded article. This step also calls for the skill which comes from experience, for if the article is exposed to the heat too long it will be "overcured," that is, too hard and brittle for the use for which it is designed; and again if the product is undercured it will be too soft and will fail to stand up in service.

Three Types of Rubber Tires. Three types of tires have been developed for use on motor trucks: the solid, the cushion, and the pneumatic. The solid tire, as its name implies, is a solid band of rubber vulcanized directly on a steel base which is either pressed on to the truck wheel or attached by clamps and bolts. The cushion tire is a solid tire generally made from a specially resilient compound, and having a contour so designed as to be soft and yielding under pressure. The pneumatic tire may be the ordinary tire used on passenger cars or it may be a tire of special construction known as the "heavy duty pneumatic," for use on large trucks.

Let us see how these three types came to be developed. Before gas engines were adapted to wagons used for hauling freight, solid rubber tires were used almost exclusively on the wheels of light carriages to provide easier riding. They performed no tractive effort, as of course the wheels were merely rolling members while well shod horses did the pulling. Such tires were held in place by means of wires embedded circumferentially

in the rubber, the whole unit being mounted in a steel channel on the felloe of the wheel (Figure 240). These tires had the advantage of being easily applied, as they were generally kept in stock in endless lengths by dealers and blacksmiths, who could cut off the necessary lengths and quickly fit them to wheels of any diameter. On the other hand, they had certain

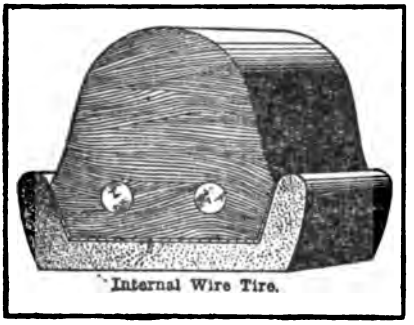


FIGURE 240

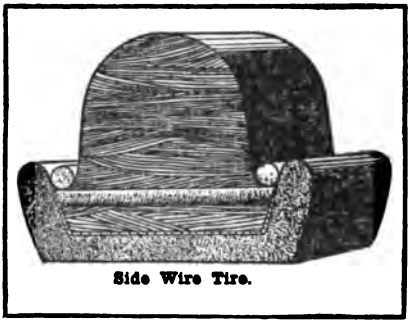


FIGURE 241

disadvantages, such as slipping in the channel, and cutting at the base, due to repeated pressure and release of the rubber adjacent to the embedded wires.

The Side-Wire Tire. For heavier vehicles, tires of the internal wire type did not prove satisfactory because the extra weight tended to induce slipping and base-cutting long before the tires themselves were worn out. A new type of tire was therefore developed in an effort to overcome these shortcomings, known as the side-wire type (Figure 241). In general shape and appearance it was the same as the earlier tire. The chief difference was that it was retained in the channel by means of short cross-wires embedded in the base of the tire, which projected on either side. These cross-wires were held in place as securely as possible by two other wires of high-carbon steel running circumferentially around the base just inside the edges of the channel. The firmer attachment of these tires to the wheel made it possible to use much larger sizes and consequently they were guaranteed by the manufacturers to carry heavier loads, which they did, with fair success.

It will be remembered that up to this time the vehicles on which these tires were used had all been drawn by horses. With the introduction of motor-driven wagons, however, an entirely new and different function was required of the tires, namely, that

of transmitting the driving power from the rim of the wheel to the road surface. In other words, the tires became part of a tractive rather than a rolling member. At the same time they were called upon to carry much heavier loads than ever before, both on account of the weight of the engine and driving mechanism and because it was found that the power afforded by the engine was sufficient to move much heavier loads than those hauled by

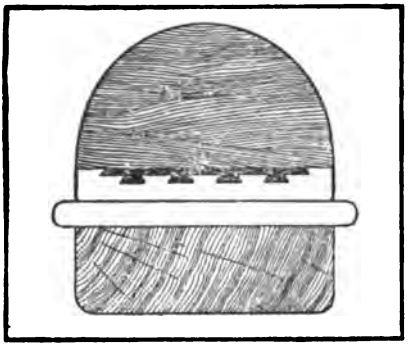


FIGURE 242

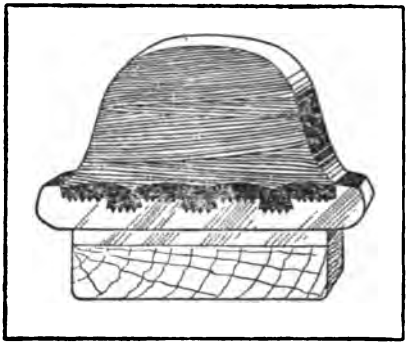


FIGURE 243

horses. The shortcomings of the wire-retained tire, already too apparent in horse-drawn service, were thus intensified under the new conditions of motor-driven work. Slipping within the channel became almost inevitable under the heavy loads, while base-separation became the rule rather than the exception. Hence, it became necessary to find some other type of tire which would last longer, and do its work better.

The Steel-Base Tire. At this point America turned to Europe to see how these conditions were met abroad. European truck tires, it was found, were built with a steel base having dovetailed grooves on the upper surface into which a layer of hard rubber was forced, while the tread was vulcanized inseparably to the hard rubber (Figure 242). This construction possessed important advantages over the side-wire tire. First, the steel base, pressed directly over the steel rim of the wheel, afforded a permanent fastening quite impossible with the wire-retained type. If the hard and soft rubber could be made to hold to the rim, therefore, uninterrupted service might be secured. This new type had one notable disadvantage, viz., it required the use of a powerful press to force it into position on the rim. While the need for applying presses in various parts

of the country retarded the use of this tire in the United States, its advantages so far outweighed its disadvantages that it was adopted in place of the side-wire truck tire.

The Introduction of Demountable Tires. The tremendous increase in the number of trucks used, especially in the smaller cities and towns, in which hydraulic forcing presses were not available for the application and removal of tires, made it seem desirable to produce a demountable tire which could be applied quickly and easily without a press. Some tire manufacturers attempted to meet this problem by building tires large enough to slip on over the permanent band of the wheel, holding them in place by means of wedges. This type, however, has not proved so satisfactory as the pressed-on tire.

With the great increase in the use of trucks the matter of service became of critical importance, for truck tires must not only be sold but put on as well, and this requires men, organization and equipment. The expense of this service, moreover, has been greatly increased by the hydraulic press made indispensable by the growing popularity of the pressed-on type of tire, with its advantages of lighter weight, and surer, simpler application.

What should the truck owner look for in the way of service facilities? A place should be provided for the truck to drive in while the tire change is being made, as in many cities the law is strict against owners who permit their trucks to stand a long time on the busy city street, not to mention the danger of leaving a truck jacked up with one or more wheels off while dense traffic passes close by. Men should be available to jack the truck up and block it securely. Removing the wheel is often a very difficult operation, and may actually consume hours unless the driver is assisted by trained men. (Figure 244.) Truck wheels should be measured by those familiar with the details of wheel dimensions. Frequently wheel alterations are advisable, particularly with old wheels, and if these are not taken care of serious damage may result to the wheel and truck.

Service Equipment for Steel-Base Tires. Special equipment (Figures 245 and 246) must be provided to handle the wheel expeditiously, and carry it, with safety to the workmen, to the application room. Here a complete line of tools and equipment is necessary, such as wrenches, saws, cold chisels, hoists, jacks, bars, timbers, sledge hammers, and power drills. The old

tire must be taken off, frequently a difficult job, especially if it is "frozen" to the wheel, a job requiring special tools and equipment. Truck wheels are heavy, and sometimes weigh, with the tires on, as much as 1,500 pounds. The new tire must be applied. This requires strength and skill, for on the manner of application depends to a large extent whether the tire is securely seated and will give uninterrupted service. Then the wheel must be taken back to the truck, put on, and the blocks removed before we can say that the sale of the truck tire has been completed. This work, which is arduous, bears a critical relation to operating efficiency and requires men and equipment which are expensive.

Adequate Service Expensive. The cost of such complete and well-organized service can only be supported by a large volume of business. The company which starts up overnight cannot afford to establish this kind of service, no matter how good its intentions. Thus while over a hundred companies have sprung up to manufacture pneumatic tires, which can be jobbed, stocked, and sold over the counter by thousands of dealers, the makers of solid truck tires in this country can be counted on the fingers of the two hands and the majority have established efficient service only in the larger centers.

How Tires are Guaranteed. When side-wire or internal wire tires were used, they were guaranteed for ninety days. This relatively short term of service was guaranteed because such tires were liable to tear off from their fastenings, even when the tread of the tire was new or in comparatively good condition, and in no way defective. With the introduction of steel-base tires, however, guarantees were extended, in some cases to a year, in others to service measured in thousands of miles. The mileage guarantee had the advantage of accuracy but did not protect the maker against false claims. The reverse was true of the time guarantee.

Standard guarantees on solid truck tires today are based on mileage, time, normal conditions of use, and carrying capacity. The following guarantee, used by a large tire manufacturer, is fairly representative:

"We guarantee that truck tires will develop no defects of material or workmanship under the following conditions:

(1) When used in accordance with our regular schedule of carrying capacities.

(2) When used under normal road conditions and not injured by accident, abuse, or the use of non-skid devices.

(3) When their service on gas trucks does not exceed 7,000 miles in one year from date of application or 8,000 miles in eighteen months on electric trucks.

"Tires returned for consideration under this guarantee will be accepted only when transportation charges are prepaid. If, upon examination, it is our judgment that they are defective, we agree to repair or replace them with other tires at our option, making a proportionate charge for the time or mileage service based on the price of the tires at the time the adjustment is made."

The terms governing mileage, time, and normal use may be considered as almost standard with most tire companies. The matter of carrying capacity is variously handled. Tire companies print schedules giving the carrying capacities of their tires. One company specifies a certain weight per inch of tire width regardless of the diameter of the tire or the speed at which it is operated. Another tire company sets a maximum rate of speed according to the width of the tire, but allows a slightly greater carrying capacity as the diameter is increased.

How Overloading Affects Tires. To begin with, be sure that your truck is delivered to you with adequate original tire equipment. Some truck manufacturers guarantee their machines to carry a 50% overload without injury. Regardless of what effect this may have on the mechanism of the truck, it is merely inviting the user to destroy his tires prematurely by placing on them a greater strain than they can endure.

Let us see what effect this overloading has on solid truck tires. Perhaps the best way to explain this is to compare it with the behavior of an ordinary rubber band under tension. When you stretch a strong, properly vulcanized piece of rubber and then release it after a moderate strain it will snap back into its original shape. You can do this indefinitely and it will continue to "come back." But if you stretch it until it breaks it can never be restored to its original form. The damage has been done, and the rupture is permanent. In the same way you may within certain limits compress a piece of properly vulcanized rubber if it is not confined, and when it is released it will spring back to its original shape and size. But what is this compression? In reality, it is only another way of stretching the rubber. In the case of the tire, the force of the load merely tends to displace the gum immediately between it and the road. This rubber, in turn, pushes aside the adjacent particles. When

the force of this distortion, now exerted in a lateral direction, becomes greater than the ability of the rubber to hold together, it will give way. The effect is exactly the same as stretching the band beyond its limit. In the case of the latter, however, the rupture extends completely across the section, and the band gives way with a snap, while in the tire the separation may not be apparent because the broken parts are held in place by others not yet noticeably affected. (Figure 247.) Nevertheless, the strength of the tire has been vitally impaired, and it will be but a comparatively short time before the tread separates entirely from the base, like the break in the rubber band—hence the great danger of ruining solid tires from once overloading them.

Overloading has another effect—it increases the tractive effort necessary to turn the driving wheels. Thus the use of trailers may have much the same effect as overloading the truck, and larger tires should be specified on trucks used in that service. Improper loading of the truck may also have the effect of straining one or more tires, although the total load carried may be within the truck's capacity. This condition is sometimes met with when heavy material, such as lumber, pipe, or steel beams is allowed to project over the tailboard and exert a crushing leverage which is ruinous to the tires.

The Effect of Overspeeding. Figure 248 shows the effects on a truck tire of the impact with road irregularities, and of the heat generated by overspeeding. A solid tire, which is overspeeded, is prematurely destroyed in a manner very similar to that of an overloaded tire. As the wheel revolves at excessive speed, the rapidity of contraction and expansion of the tire generates internal frictional heat. The internal heat is raised to a high degree by friction with the road, and so the tire is heated to a higher temperature than that which it can resist.

This excessive heat alone would ruin the rubber in the tire, but, in addition to it, there is the greater probability of its rupture, as the contact at high speed with irregularities in the road surface greatly increases the effect of all shocks.

Neglected Cuts. Cuts more or less severe are of common occurrence. This injury is governed largely by the road conditions. The ultimate effect of a cut depends on its size and location. Cuts near the edge are most injurious, and, if neglected, may seriously affect the life of the tire. The tendency

FIGURE 244: Applying pressed-on tires is no child's play. It requires skilled and expensive equipment.

FIGURE 245: This is one of several types of hydraulic presses for properly applying pressed-on tires.

FIGURE 246: Solid tires are not wrapped up and sold over the counter—they must be put on your truck wheels. This requires equipment. It is essential then to find out what service is available, before you "tie up" with any make of tire.

FIGURE 247: Overloading ruins tires in exactly the same way that overstretching snaps a rubber band.

FIGURE 248: Overspeeding causes overheating and increases the force of destructive road shocks.

FIGURE 249: Neglected cuts should immediately be trimmed. Otherwise they may tear off the entire tread.

FIGURE 250: Skidding subjects the tires to an unusual strain as does also an improperly adjusted brake.

FIGURE 251: Most anti-skid devices are very hard on tires. Don't use them unless it is absolutely necessary.

FIGURE 252: Most anyone would guess that constant running in street car tracks ruined this tire.

FIGURE 253: Sometimes a bent axle causes the wheels to run out of alignment. This too, ruins the tires.

FIGURE 254: On rough road, tires rest on irregularities. This has the effect of overloading certains parts of the tire.

FIGURE 255: This truck is hauling four times its capacity by means of ordinary wagons "trailed" behind. The same load, if placed on top of the truck would break it down or damage it seriously. See Chapter XI for explanation.

FIGURE 256: These trailers are nothing more or less than wagons. While it is true that for regular trailer service ordinary wagons do not stand up, yet for occasional needs or emergency requirements the use of wagons often proves economical.

of such cuts is always to enlarge, especially in a circumferential direction. Some trucks are backed up a great deal, and are cut from severe contact with curbstones.

The weakening of one unit of a dual tire in this manner naturally throws an overload on its mate at the point of injury and will cause it to fail.

If cuts are not properly trimmed the torn rubber or "flag" catches as the wheel revolves and so enlarges. (Figure 249.) Neglected cuts have developed to such an extent that they have caught in frogs of car tracks and torn off practically the whole tread.

To prevent the progress of a cut on the edge of a tire, bevel it off with a sharp knife. This is so important that tires should be carefully inspected at the end of each day's work.

Why Skidding Ruins Tires. Skidding or locking the brakes and sliding the wheels results in serious and uncalled-for damage. This has a ruinous effect on the mechanism of the truck, and causes as well irreparable damage to the treads of the tires. It subjects the tires to an unusual side strain in addition to the work which they must perform in supporting and propelling the truck and its load.

Figure 250 shows practically new dual tires from which the tread for a short distance was literally torn as the result of this practice. A truck will not stop as quickly in this manner as it will if the brakes are applied slowly and firmly. Improperly adjusted brakes will sometimes cause one wheel to lock, which grinds or tears off a section of the tire.

As soon as a truck starts to skid it should be steered, if possible, in the direction of the skid. Trucks carefully driven will not skid ordinarily except under abnormal conditions. Turning around corners too rapidly increases the strain and wear on tires with a similar ultimate effect.

Anti-Skid Devices. The loose chain has been found the least injurious, as it works itself around the wheel and provides an equal distribution of the wear and strain. Stationary devices are most injurious because the wear and strain are constantly confined at the points of bearing.

The traction (rear) wheels are liable to spin more or less in slippery places, and this produces a sharp blow on the tires where these devices are in contact. It is advisable to use a device having numerous cross-pieces, as the wheel gains momen-

tum between these points, and the greater the distance the more severe the blow. Less injury will result if such devices are used only temporarily to pass over soft, slippery places. Great injury results from careless and continued use of anti-skid devices on pavements or hard roads where there is little or no need for them. (Figure 251.)

Running in Car Tracks. Injuries resulting from running solid tires in car tracks are serious and readily apparent. (Figure 252.) Their construction does not permit of ready distribution of a part of the load to the lower flange of the rail, so the major part of the load is carried upon the upper section of the car rail. This throws the entire load on one half of the tire tread with the result that it is rapidly worn or broken away on that side, eventually leaving the tire, reduced by one-half, to carry the full load. It is obvious that a tire will prematurely fail under these conditions.

Wheels Out of Alignment. If the front wheels of a motor truck are out of alignment, that is to say, either toe-in or toe-out to even a limited extent, the tires may be worn out in a few hundred miles of travel. But why is this? The reason is, that the wheels not only revolve, but they are also dragged slightly over the ground. For instance, if one tire is headed in a direction a little to one side of the forward direction of the truck it will tend to turn toward that side. Because of the general direction of the truck, however, this tire is continually being dragged back into place, as it were. Thus the tire slides as well as rolls and is worn out almost as quickly as if it were filed away. (Figure 253.) This misalignment is often caused by a bent axle. A simple inspection may be made by measuring the distance between the rims of each pair of wheels. Find this distance first, with respect to the front and then with respect to the rear of each pair of wheels.

Bad Roads. Bad roads are obviously injurious to solid tires. On a road with a rough surface the tire rests successively on irregularities, which have the effect of overloading that particular portion of the tire. The tread of the tire in Figure 254 shows the disintegrating effect of these momentary overloads as well as the places where pieces of rubber were actually cut out by running over crushed stone, loose brick and similar materials destructive to solid tires.

Oil is the natural enemy of rubber. If a piece of rubber is dropped in a can of gasoline, it will soon dissolve. Oil and grease of all kinds will soon change the nature of rubber. Be sure that no pools of oil are left standing on the garage floor, and clean off any grease that may have lodged on the tire.

How Truck Tire Adjustments are Made. Suppose the owner neglects his tires. Who pays for these abuses? In guaranteeing the truck exclusive of the tires, the truck manufacturer conveniently arranges to "step out from under." The burden therefore seems to fall upon the truck owner or the tire maker. As a matter of fact, however, the "ultimate consumer" bears most of the load. When tires fail prematurely, the truck owner looks to the tire maker for adjustment.

Many users seem to feel that because their *average* loads do not exceed the rated carrying capacities of their tires, they have not overloaded them, and consequently the rubber manufacturer should furnish other tires, free, to run out the guaranteed mileage. As there is no gage by which the loads carried may be recorded, the tire maker has to accept the statement of the truck owner, or run the risk of an unpleasant controversy if he questions it. The truck is laid up—or perhaps merely the tire, if it is of the demountable type—and an adjustment or a paid renewal is made, prematurely. Either method of settlement is more costly than continued service under proper conditions. The truck owner complains that the cost of maintenance is higher than it had been represented to him, although the chances are he had not been impressed with the high cost of tire abuses. It is admittedly not sound business for a manufacturer to replace an article without due charge, if the user of the commodity has wittingly or unwittingly destroyed it. In self-protection, therefore, as well as for the education of the truck user, the tire makers sometimes have controversies through which they have to pay their share. Occasionally these contentions result in the loss of the customer, who decides to use another make of tire. In such cases, they feel that they have merely transferrred an undesirable account to a competitor, who in turn, takes up the burden.

As a matter of fact, most adjustments are compromises. The user and the tire company meet somewhere in between their respective claims, and each sustains a relative loss.

CHAPTER XXIII

SELECTING THE RIGHT TIRES

THE regular steel base solid tire is, of course, the average choice for service under conditions where fairly heavy loads are carried. While such tires do not supply the resilience furnished by pneumatic tires on passenger cars, they do provide that strength and dependability in service which is necessary in this class of work. There are, however, special types of solid tires, and important developments in construction with which the truck owner should acquaint himself.

Block Tires. In the past, not a few truck operators have thought it advisable to equip the rear wheels of their trucks with block or sectional tires to give traction and prevent skidding. This practice is fast disappearing. It is being realized that the chief factor in giving traction to wheels is pressure—the locomotive illustrates this fact. Block tires have failed to give much, if any additional traction. Moreover, as they are more vulnerable under severe conditions of service and present difficulties in the use of skid chains when necessary, the principal tire companies have ceased to make them. In the Great War, road conditions were met with requiring the utmost in tractive grip, and blocks proved a failure and were discarded in favor of continuous tires, upon which chains could be used when necessary. This may well be regarded as an authoritative test.

"High Section" Tires. One of the most noticeable recent tendencies in solid tire practice is toward the development of a tire of high section. Several important benefits are derived from this construction. The first and most obvious is increased mileage. Another advantage is increased carrying capacity due to the additional rubber on the top of the tire. This, however, gradually decreases with the wear of the tire. A third result is found in the reduced vibration of the truck, which is perhaps the most important of all.

Vibration is the truck's worst enemy, for it crystallizes steel parts, and works havoc with the engine, frame, axles, springs, transmission, steering gear, and other vital parts. The truck, carrying as it does, a load from four to twenty times as heavy as a touring car, must be equipped with springs which are from four to twenty times as stiff. As springs cannot be made more flexible, extra cushioning must begin and end with the tire.

A fourth result is an economy in the use of driving power, for the high section tire, by reason of its greater depth of cushion, absorbs many of the inequalities of the road in its own tread, whereas a shallower tire makes the truck climb over them, consequently requiring more power.

Large Singles Compared with Small Duals. Another striking tendency has been toward the use of large single tires in place of small duals. Very much the same reasoning was employed as in creating the high section tire, namely, that as most roads are irregular in surface and sloping in profile, the tire, whether single or dual, which travels the narrower path will meet fewer irregularities and therefore bear with a greater proportion of its width on the ground. The dual tire, of course, travels a much wider path than a single tire of similar capacity by reason of the space between the two members of the dual tire, which, at the points of contact with the road, amounts to nearly three inches.

Mr. W. H. Allen, of the Society of Automotive Engineers, has summed up the advantages of this practice as follows:

"Numerous advantages are gained through the substitution of 5-, 6- and 7-inch single tires for 3-, 3½- and 4-inch dual tires. Chief among these are:

(1) Saving in tire cost ranging between 8% and 15%.

(2) Saving in wheel cost. The reduced wheel cost is attributable to the narrower felloe stock and wheel rim required, together with whatever other saving may be made in connection with wheel design. The same reasoning also applies to metal wheels.

(3) Saving in cost of handling and applying one tire instead of two.

(4) Saving in wheel, tire, and rim weight, resulting in possible greater operating economy and relieving unsprung weight.

(5) Larger tire that will adapt itself better to uneven road surfaces, compensate for excessive road crown, carrying its burden as a unit rather than alternately on one narrow tread and then on the other.

(6) Greater ease of fitting non-skid chains.

(7) Better tracking with front wheels (an advantage when tracks must be broken).

(8) Usually greater height of rubber tread, thus providing greater cushioning properties with consequently increased tire and vehicle life.

(9) Decreased strain on axle and wheel bearings as a result of decreased leverage obtained by the narrower wheel tread.

(10) Operating economies that will follow the use of large singles, if a deeper section than that commonly used be employed. The tire service in each case under observation has shown very material improvement."

There are limitations, however, to this practice, according to the same authority, who says:

"The question will quite naturally arise, 'If single tires in the sizes quoted possess advantages over dual tires composed of small units, why does not the same reasoning apply to single tires of sufficient width to replace the largest of dual tires?' Such practice may be possible, although developments to date have not been sufficiently conclusive in this respect to warrant the extension of the recommendation made beyond the ranges given. Perhaps it will be shown that a well-defined limit exists, beyond which additional bulk cannot be successfully employed, from either a production or service standpoint, in a solid single tire. Pending results of further investigation and of experiments being conducted, it seems advisable to consider 7-inch tires as the limit of practicable single equipment."

Special Electric Tires. The decision of the Motor Transport Division of the United States Army to use six inch dual tires in place of ten inch singles after trying both types, seems to confirm this point. The cost of current, or the distance which the electric truck can travel on one battery charge is an important consideration. The owner should select a tire which enables his battery to give the maximum mileage, provided that such a tire does not gain its special quality at the expense of its own strength or durability. But this is often the case, for it should be observed such tires are generally guaranteed for use on electrics exclusively. Now the quality of extra resilience which they possess is a desirable one for tires used on gasoline trucks. That such tires are not guaranteed on gasoline trucks, however, is a clear indication that sturdiness has been sacrificed for softness and that these tires, specially designed for use on electric trucks, are not expected to have the durability of tires made for service on gasoline trucks.

What qualities in a tire make for low current consumption? It is a most baffling question. No one as yet has been able to give a complete and accurate answer.

Rolling Friction. The condition nearest to the ideal with respect to rolling friction is found in the locomotive wheel on the steel rail. The resistance encountered by steel wheels roll-

ing on heavy clean rails is about nine pounds per ton carried. If all our roads were as smooth and hard as steel rails, our vehicles would presumably have steel tires. Under such conditions, solid tires of the very stiffest and hardest compound would consume less current than pneumatics.

Unfortunately, however, road surfaces possess innumerable humps and depressions of every kind, which the vehicle wheels must pass over. A hump in the surface of the road is nothing more or less than a little hill which the truck has to climb before it can get over. Both the hard tire and the soft tire must climb this hill. The very hard tire climbs the whole distance, but the soft tire surmounts the obstruction by climbing, let us say, half the height, and the other half it absorbs by indentation into its resilient and efficient tread. This does not amount to much in the case of one or two humps in the road. A truck, however, in the course of a day's run may, and probably does, encounter many thousands of these local irregularities, and at the conclusion of the day's service, it may be figured that the very hard tire has caused the truck to lift its own weight possibly a total of over 100 feet higher than the soft tire. Softness, therefore, seems to be a requisite of low current consumption.

Requirements of Tires for Electrics. How soft or yielding should a tire be? This depends upon several factors—there are conditions in which a harder tire consumes less current than a soft one. A tire can be too soft and "drag," consuming an excessive amount of current.

Is mere softness enough? Decidedly not. Consider how much effort it takes to walk over soggy ground, or even over soft sand. The footing yields and consumes most of the energy of the walker without giving it back. It is much easier to walk over dry and springy turf; or in leather shoes rather than shoes of heavy felt. In this quality of springiness or "kickback" we find perhaps the most authentic indication of efficiency from the point of view of current consumption.

How Tires are Tested for Electric Trucks. Certain experiments have been devised for testing the efficiency of tires with respect to current consumption on electric trucks. These tests are described in a report adopted by the Electric Vehicle section of the National Electric Light Association at its thirty-ninth convention held in Chicago, recently, of which we give a brief summary:

"*Road Test.*—In this test a chassis is loaded to normal capacity by means of accurate weights and driven over a measured course at a constant speed. The records kept in such a test consist of the time consumed in covering the course, volts, amperes, atmospheric temperature, wind velocity and direction, and road conditions. In some cases ampere hour meters are used to show the total current consumed, but as a general rule fully charged batteries are used in each individual test and total watts or ampere draw used as a basis for comparison. The tires showing the greatest efficiency covered the course at the greatest speed and with the lowest ampere draw or watt hour reading.

"There are many chances for inaccuracies in making this test, and unless tires of different types or makes are tested under identical conditions a fair comparison cannot be made. For example, it will be observed that an accurate comparison cannot be made if two sets of tires are applied to different chassis, even though they are of the same weight and capacity. The friction and other losses of the moving parts, as well as the efficiency of motor and batteries, might vary so widely as to cause an apparent increase in power consumption not attributable to the tires.

"Since differences in atmospheric conditions during separate tests will be reflected in the final results, accurate comparisons may be expected only where practically identical weather conditions prevail. Since atmospheric conditions also affect road conditions, the same set of tires would not show the same results if tested on a dry course as over the same route after being wet. Temperature also plays an important part in affecting road conditions. This can be best illustrated in the case of an asphalt street. On a hot day the asphalt will soften, causing the tire to stick or drag and consume a greater amount of current than on a cold day when the asphalt will harden perceptibly, making a much faster course. Wind resistance should also be constant in making these comparisons, for it is obvious that more current will be required in running into a 20-mile-an-hour wind than one whose velocity is 10 or even 15 miles per hour.

"The course over which road tests are run is usually either asphalt or good brick, and the final results show current efficiency and speed over but one kind of road surface. In actual service the average electric vehicle meets all varieties of road and street construction, and as the tire most efficient on good hard asphalt may show decreased efficiency over brick or cobble stones, and *vice versa*, the most satisfactory course for a test is one including the greatest varieties of paving. In this case an accurate average performance may be obtained. While the road test is theoretically the most accurate in determining the tire or tires with highest current efficiency, in order that dependable results may be obtained the foregoing conditions must be as nearly constant as possible and the testing course should be a fair average of actual street conditions.

"*Grade Test.*—The grade test consists simply of noting the length of time elapsing from the instant the brakes are released on a vehicle, standing on a 20% grade, to the instant of passing the end of the grade. In this test, time only is figured, for no current is required, and as the grade is usually artificial not much dependence can be placed upon the results. Should the same complete chassis be used in testing various makes of tires, the results would be fairly reliable for comparison only, but the conditions under which the test is made are theoretically too perfect for drawing accurate conclusions with respect to results in actual service.

"*Coasting Test.*—This test is very similar to the grade test except that distance is the basis of comparison rather than speed. In making the coasting test the machine is run at highest speed up to a marked point, at which the downgrade begins. Here the power is cut off and the vehicle allowed to coast until coming to a standstill. Many of the variable factors are encountered in this test as outlined in the road test, but, in the main, the results are fairly accurate for comparison.

"*Impression Test.*—This is a minor test used by one or two manufacturers and the results obtained are inadequate and unconvincing in comparing the efficiency of tires. The test is conducted by jacking a wheel from the floor, chalking the surface of the tire and removing the jack, allowing the wheel to drop upon a piece of cardboard or heavy paper. Upon removing the cardboard an impression of the length and width of the arc of contact is obtained. By comparing these arcs for various tires, the results are supposed to show the comparative hardness. However, even these results are inaccurate for different shapes, and the test can best be used as a check for uniformity in tires of the same make and shape. Efficiency in current consumption and speed cannot be determined by this test.

"*The Scleroscope.*—The scleroscope (Figure 257), an instrument primarily designed for testing the hardness of metals, is sometimes used to compare tires for efficiency. This instrument has been accepted as a standard by different authorities for testing hardness of steel, and consists mainly of a glass tube, graduated to scale, through which a weight is dropped and the rebound observed on the scale. The results from this instrument are obtained by dropping a weight upon the tire and noting the rebound, the more resilient tires showing the greater rebound. This test is not accurate for tires or rubber compounds, unless test pieces of the same dimensions are used. The difference in the shapes of tires as well as the possibility that the tube may not be perfectly vertical for all tests, allow a great chance for inaccuracies. Again, the testing conditions are more nearly ideal than those in actual tire service.

"*The Yield Gage.*—Nearly everyone is familiar with the common practice of testing the resilience of rubber by biting specimens with the teeth or pressing with the fingers. Since these are very unsatisfactory methods, an instrument known as the yield gage (Figure 258) has been produced to take the place of the uncertain element of 'feeling.' By pressing the blunt end of the gage against the tire to be tested, the amount of resistance to the pressure of a standard spring balance is shown on a graduated scale. This test results in only a determination of the hardness of various tires, hence is not reliable for tire efficiency in point of current consumption, but is a fairly accurate check for compounds found to be up to requirements in this regard.

"*Dynamometer Test.*—The dynamometer test consists of mounting the tire to be tested and rolling it against a steel-tired wheel, the resistance to rolling being determined in pounds at various speeds and pressures. Mr. F. E. Whitney, of the Commercial Truck Company of America, has designed a dynamometer for this purpose from which he states he has secured very accurate comparative results. It consists briefly of the rear construction of a worm drive light delivery wagon made up with only one wheel. A second wheel having a steel tire is mounted by ball-bearing pivots concentric with the motor-driven wheel so that frame and wheel can swing. This wheel is mounted on

annular bearings in such a way that it can move in and out and can be pressed against the test tire by means of a coil spring. Frame and wheel are counterbalanced. When pressure is applied and the wheel is rotated, there is a tendency for the wheel frame to rotate with the wheel. This tendency is measured in pounds by a spring balance.

"It will be seen from this discussion that the tests at present used to determine tire efficiency are inadequate. This could hardly be otherwise, in view of the many variables which surround and influence the conditions of any test. In general, tests made inside the laboratory are more subject to question than those in which an attempt is made to reproduce actual running conditions. The road test, first mentioned, seems to be the most convincing if made under average and not ideal conditions."

Cushion Tires for Electrics. Cushion type solid tires are used to some extent on electric trucks as well as light gasoline-driven commercial vehicles. In point of capacity they are limited; it becomes necessary to use a stiffer compound than that used in pleasure vehicle service, and a limit is reached beyond which even this fails to be of service. In point of reliability they are more efficient than the pneumatic, but here also they are limited at most to trucks of medium weight. Their "gingerbread" construction renders them peculiarly vulnerable to the punishment of the road and under compression of heavy loads the tread spreads out laterally, and in this unprotected shape is liable to be lopped off by sharp objects in the streets, especially car tracks. In point of reliability the cushion type cannot be rated much higher than the pneumatic. Respecting low cost of operation, the cushion type can be rated as only fair, its first cost is rather high, and except on very light trucks, it is short-lived. On electric trucks it is fairly efficient as regards current consumption, and also in its effect on the upkeep of the truck. As to speed, it lies half way between the pneumatic and the regular solid, but, as indicated above, the whole matter of speed of electric trucks is contained within such a moderate compass that variations one way or the other are not of great commercial importance.

The Field of Pneumatics. Few persons realize the extent to which pneumatic tires are being used on motor trucks. The great number of light delivery cars, used by the grocer, the laundry man, the dry goods merchant, and dozens of other tradesmen—cars ranging up to 1½ tons' capacity and equipped with pneumatic tires—constitute a large part, almost a majority of the total number of power wagons used in commercial service. Pneumatic truck tires are, in fact, almost as numerous as solids.

Let us consider the most important advantages and disadvantages of the pneumatic tire for motor trucks. First among its advantages is its capacity for speed. Light trucks equipped with pneumatic tires can be driven practically as fast as passenger automobiles. This is of great importance because, as the carrying capacity of such trucks is about the same as that of the horse-drawn wagon, it can exceed the performance of the horse only by greater speed, and consequently by a greater number of trips. The horse averages from three to four miles an hour. Light delivery trucks, equipped with pneumatic tires, often make twenty or thirty miles an hour.

The pneumatic tire reduces to a minimum the vibration which comes from road shocks. In this respect it still stands supreme, and no invention or device, whether spring wheel or cushion tire, has approached it. The lightness of the pneumatic is another advantage, for it dispenses with the heavy rims and steel bases required by solid tire construction. Ease of renewal is a feature in its favor, for spare tires can be carried on the truck and applied in a few minutes' time, thus avoiding dependence on press or service facilities which may be located at a distance.

Finally, pneumatic tires reduce the cost of upkeep and operation of the truck, for there is less racking of the mechanism through vibration. Moreover, the consumption of gasoline or current is not so great as when solid tires are used.

Some Disadvantages of Pneumatic Tires. In spite of these advantages, however, certain important disadvantages of the pneumatic must be taken into consideration. First is its liability to puncture and blow out. This can hardly be guarded against, and greatly increases the final cost of pneumatic equipment. Moreover, when such accidents occur on the road, they affect the service end of the transportation business by causing troublesome and often damaging delays and sometimes losing the customer's business.

A second disadvantage is its limited normal carrying capacity. It has been found impracticable to use the regular pneumatic tire on trucks greater than a ton and a half in capacity. Its strength is limited, and heavy loads break it down inevitably.

This limitation has been felt severely by the user of heavier trucks, of which the possible speed and consequently the effectiveness has been virtually cut in half by the necessity of using less resilient tires. As a result, determined efforts have been

made and are still being made to develop a pneumatic tire which shall be able to stand up under heavier loads than the ordinary pneumatic.

The Pneumatic of the Future. Serious difficulties still confront this effort. First, the great carrying capacities, which such tires must be designed for, require high air pressure, which may amount to 120 or 140 pounds per inch. Moreover, there are very few pneumatic pressure tanks available for blowing up tires to this pressure. Again, it is necessary to devise some rugged kind of puncture-proof construction which will resist the penetration of sharp objects under great pressure. Moreover, some way must be found of reducing the internal heat which is generated under high speed and great pressure.

The advantages which would be derived, however, from such a tire are so great that we may feel confident these obstacles, serious though they seem at present, will eventually be overcome. The "heavy duty pneumatic" tire, which is still in the development stage, promises, when perfected, to revolutionize the design and the performance of heavy trucks.

Changing from Pneumatics to Solids. Occasionally truck owners, dissatisfied with the performance of pneumatic tires, change over to solid equipment, or vice versa. This practice is dangerous. It should be remembered that a truck built for use on pneumatic tires is designed to stand strains which are not nearly so great as would be produced by solid tires. This is apparent to the eye, for instance, in the construction of the wheels, which are light and almost frail looking in comparison with wheels built for solid tires. Not only the wheels, however, but the axles, springs, frame, and almost every part of the truck is lighter than the same part in a solid-tired truck. The truck operator should ask the advice of the manufacturer of the truck before making any such change, for it is likely that the amount saved in tires may be more than offset by the increased cost of maintenance of the mechanism of the truck.

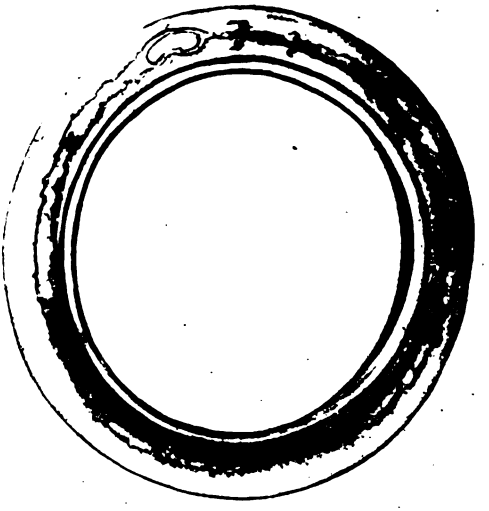
How Pneumatic Tires are Adjusted. Adjustments on pneumatic tires are handled in much the same way as with solids. Carrying capacities are, of course, much smaller and the mileage guaranteed is generally 3,500. Again, both tire user and the maker generally suffer a loss in adjustments, and the most economical plan here, as with solid tires, is to avoid

FIGURE 257: The scleroscope is sometimes used to advantage in testing the relative efficiency of various tires.

FIGURE 258. By pressing a yield gage against a tire the amount of resistance is registered on a graduated scale.

FIGURE 259: Roads like these may be ideal to test the power behind a four-wheel-drive truck as this one happens to be, but with this one exception it would be difficult to find any other excuse for their existence.

SKIDDING



RUT WORN

BLOW OUT FROM
NEGLECTED REPAIRS

FABRIC BROKEN
FROM A BRUISE

FIGURE 260: The illustrations on this and the opposite page will serve well to illustrate the damage to pneumatic tires resulting from the common abuses to which they are subjected. It scarcely demands expert knowledge of tire construction to identify the abuses which ruined these tires.

UNDER INFLATION

NEGLECTED CUTS

INJURED BY CHAINS

FAULTY ALIGNMENT

FIGURE 261: Tire damages such as depicted here are the results of either carelessness or ignorance on the part of the driver, unless he has not been "coached" in the results of abusing them. The latter is very often the case and is a responsibility which is really up to the truck owner himself.

FIGURE 262: Loading a truck from a freight car generally requires hoisting buckets, but when the car is on a trestle, a pen with gates and chutes as shown above will provide a sufficient gravity flow.

FIGURE 263: On small jobs it is sometimes more economical to dispense with loading devices, but where the trucks work for weeks at a time it is often good business to install elaborate and expensive equipment, as shown here.

adjustments by avoiding those abuses which so often are the only basis of asking for adjustment.

How to Buy Truck Tires. We have described in the preceding pages the various types of truck tires and the particular qualifications of each type for special conditions of truck service. These considerations should have weight with the truck owner in his selection of tire equipment for his trucks.

TIRE RECORD

FRONT OR REAR SIZE_____ TRUCK MAKE_____ TRUCK CAPACITY_____ WHEEL NO._____

	MAKE	Tire No.	Truck No.	Put on	Taken off	Mileage	Cost		Order No.	Adjustments				Mileage	Cost		Total		Cost per Mile	Remarks
										Tire No.	Put on	Wheel No.	Taken off				Mileage	Cost		

FIGURE 264: It is well to keep track of tires on a separate form showing considerable detail. This will determine which make gives the best service. Should you require an adjustment your detailed records will do much to support your claim.

But there are other considerations, too, which should be borne in mind. One is the tire maker's guarantee. A guarantee never made a tire. Because a tire is guaranteed for a long mileage, it does not follow that you will obtain it. Excessive guarantees usually mean "endless chain adjustments," and may often be used to attract the inexperienced.

Don't let low initial price alone determine your choice. In every business transaction you have to pay for quality and experience. They are valuable to you. Tires are no exception.

CHAPTER XXIV

SOLVING THE GARAGE PROBLEM

"WHAT arrangements shall I make for garaging my trucks?" This question comes up before every truck operator, whether he operates a single truck or a large fleet. It is often a puzzling problem, for there are many things to take into consideration.

The owner must decide, for example, whether he shall rent space in a public garage, or build and maintain his own. He must determine upon a location with reference to his place of business. He must settle the important question of size, and if he builds his own garage he must post himself on such important matters of construction as lighting, heating, floor arrangement, space for truck stalls, provision for stock room, repair shop, elevators if necessary, facilities for overhauling, and a hundred and one matters which are a part of efficient garage practice. He must find out how to arrange and classify the work, and he must install an accounting system which shall keep track of his stock, his supplies, the work done by each department and the share of the expense which each truck should be charged with.

Public or Private Garage? First of all the truck owner must choose between the public garage and the garage maintained by himself. On the one hand he can send his truck every night to a public garage, have it stored, washed, perhaps oiled and sometimes even inspected for a charge which averages from a dollar a day and up, according to the service which he contracts for. This relieves him of much of the responsibility which goes with the care of a truck. He is reasonably well assured that his truck is safe, and is being taken care of by an organization equipped and trained for that kind of work.

On the other hand, the private garage presents certain advantages. Generally it can be located close by; it affords an opportunity to develop the responsibility of the driver by putting him

in charge of daily inspections and small repairs; it enables the owner to get work done at cost; to use the time of the driver when otherwise he might be idle, and best of all it enables the owner to introduce such systems of inspection and accounting as he may devise—all of which would be impossible were his trucks housed in a public garage.

In view of these considerations, how shall the merchant decide? His decision must depend upon local conditions, but the following fundamental principles have been proved sound by experience and will guide him in reaching a proper conclusion.

Size of Fleet a Factor. It has been proved that a concern owning a fleet of trucks, generally reckoned at eight or more, will do better by establishing its own garage than by renting space in a public one. The reason goes back to the problem of truck maintenance. The care and maintenance of one truck does not justify the employment of a mechanic for that purpose only. Neither does it warrant the purchase and installation of that equipment which plays so important a part in garage efficiency. One truck presents almost the same range of mechanical problems as a fleet, and requires almost as much apparatus for its care. It is generally better, therefore, for the owner of one or two trucks to avail himself of the services of a well-equipped garage. Although he pays the garage proprietor a profit for his service, it is likely that he could not render that service to himself for any less. On the other hand, the maintenance of a fleet of trucks may well keep one or more expert mechanics occupied all the time.

The location of the business is a second consideration. If a suitable garage cannot be found near at hand, the owner may be compelled to establish his own, even though other considerations do not favor it. On the other hand, if the business is located in the heart of the city, it may be unwise to use space for garage purposes which might be employed more profitably otherwise.

How One Truck Owner Solved the Problem. A third consideration is the mechanical skill of the driver. If the driver is accustomed to handling tools and making small repairs, the owner can establish a small garage with considerable hope of success. If, on the other hand, the owner finds it impossible to hire drivers who are mechanically inclined, he will lose a large part of the advantages which otherwise might be had. The truck owner should also examine into his own qualifications in

this respect. Some firms have in their employ one or more officials who happen to be skilful in mechanical matters, and are as much at home in a garage as a professional mechanic. If the owner can count on having such a man take general superintendence of the garage, he need not give so much attention to the qualifications of the driver. A western paint dealer, who operates only one truck, has the following to say on this subject:

"I have only one truck, and my driver is no great shakes for handling repairs. I might have put my trucks in a public garage, but there was none near by so I put up a portable steel garage for $300. I didn't go in for equipment because I knew it wouldn't pay. My driver has no mechanical ability to speak of, but he can tighten a nut when he's told to. Keeping a truck oiled and tightening up the loose parts are the important things, I figure. So I put up an oiling chart on the wall, and gave the driver to understand that he must follow it to the letter. I also made a list of certain parts that should be examined and adjusted every night or every week. When anything breaks we go to a repair shop and we have the truck overhauled once a year by some outside mechanic. In this way I keep the truck in trim, save a lot on rent, and use the driver's time to advantage."

Having determined upon the locality, the owner must next turn his attention to the size of the garage. While the number of trucks is the chief factor, other considerations must receive attention. Provision should be made for the future growth of the truck fleet. If this is not done by increasing the floor area above present needs, or if the plot of ground available does not permit of widening the structure, the merchant should see to it that the foundations are designed to support one or two additional stories which may be added later.

Saving Ground Space. Here the question of the one-story versus the two-story garage must be answered. While the garage having two or more stories saves ground space, and is advisable where land is expensive, as for instance in a congested part of the city, it must be remembered that such a building requires an elevator if the upper floors are to be used to full advantage. A freight elevator designed for such service should have a lifting capacity up to six or seven tons. This means a rather expensive installation. Such an elevator reduces by its own area the usable space not only of the ground floor but also of every floor through which it passes. It is slow in operation, and is more or less a source of danger to the men employed or to casual visitors in the garage.

How one merchant solved this problem is shown in Figure 265. The first floor is dropped about five feet below the level

of the street. Trucks enter over a sloping passageway wide enough for two vehicles to pass with ease. The sides of the passage are provided with strong guides made out of stout timber and high enough to prevent trucks from running off. The second floor is six feet above the street level, and is also reached

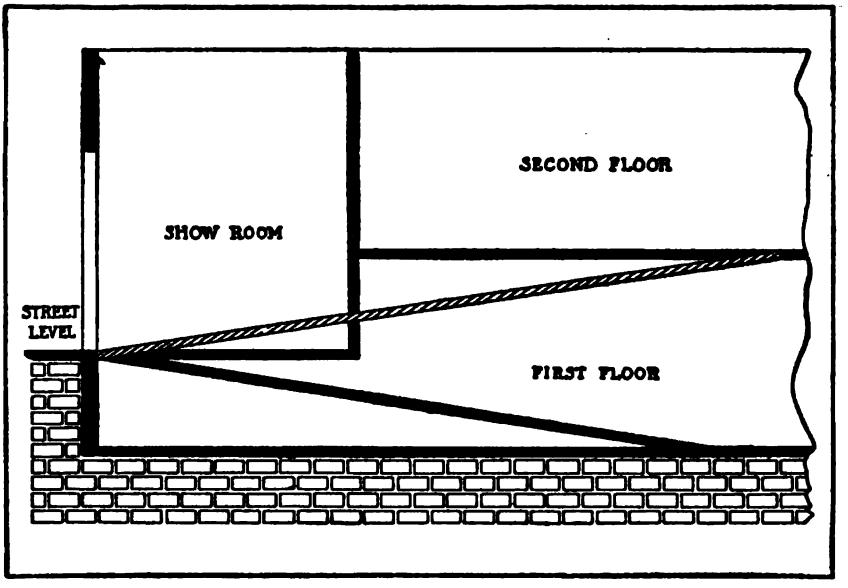


FIGURE 265: How can a two-story garage be operated without an elevator? This drawing shows how one truck owner, by means of an inclined approach eliminated a freight elevator. The incline is indicated by the diagonal lines.

by an incline. The grade of these inclines is 25%, which can be surmounted by the average truck even when carrying a full load. While these inclines take up space, they eliminate the expense and danger of an elevator and save time as well.

Importance of Garage Layout. Size, however, is not altogether a matter of area. Arrangement counts. As a fundamental principle, in designing a garage the oblong shape is to be preferred to the square. This is more apparent in the case of a large rather than a small garage. Trucks should, if possible, be backed up against a wall. In the case of a large square garage, this arrangement leaves a considerable open space in the middle. While this gives ample room for the trucks to maneuver in, it is often more than they need. This central space cannot be used for work because it is in the path which the trucks take when

entering or leaving the garage. It is, indeed, lost room, unless the owner utilizes it to park another line of trucks. But, as we have suggested, it is difficult to park trucks except by backing them against a wall. Moreover, a double line of trucks causes confusion even though there be an adequate space between them. This is apparent when trucks from both ranks try to leave at the same time. It is often a good plan to divide such a garage by a partition, leaving on one side a rectangular lane wide enough for either one row of trucks, or two rows facing each other and with a lane between, while the other side is used for supplies, office or repair shop.

Distances between walls, posts, and other obstructions are important. A garage poorly designed in this respect may have less actual capacity than a well-designed garage of less total area. The points to look to are the length and width of the trucks, and their turning radius. Posts should be spaced far enough apart to permit one, two, or three trucks, for instance, to drive between them. Two posts which are almost, but not quite far enough apart to accommodate two trucks, for example, cut down greatly the capacity of a garage.

How to Arrange Lighting Facilities. The matter of lighting is important. Good light is essential to proper inspection and maintenance. Moreover, there is no light like daylight. In these times, when great factories are built, as it would seem, more with glass than with brick, the average business man scarcely needs to be told to provide his garage with windows. Often, however, it is necessary to use a shed or barn, or other building not originally designed for garage purposes. It will pay the owner in such a case to have windows put in. It is not necessary to provide windows on every side, as it is often sufficient to build windows at one end of the improvised garage, selecting the place most suited for the inspection and overhauling of the truck.

Whether the garage, be provided with sufficient windows or not, however, an artificial lighting system must be installed. Electric light is required not only for night work, but for day work as well, where it is often necessary to concentrate light on parts of a job which daylight does not reach.

In former years, it was a common thing to see garages illuminated by arc lights. This method of lighting for garages is now entirely discredited. Instead of using two or three powerful

lights, modern practice goes to the other extreme and indorses a system employing a great many small lights. Flexibility is the important quality of the lighting system of the modern garage, and the motto is: "Bring the light to the work, not the work to the light." To that end the wiring should be arranged to provide for dozens of switches, and small lights should be placed at every bench, or other places where fine and careful work must be done.

Stalls for the Trucks. We have already said that trucks housed in a garage should be backed up against a wall. This makes it possible to maintain an even row, no one truck jutting out unduly and obstructing the lane down which all the trucks must travel in entering or leaving the garage.

Even with this arrangement, however, difficulties are sometimes encountered. A truck is liable to be backed in a few feet either to the left or the right of its appointed place, especially when the trucks whose "stalls" are on either side are out on the road. Trouble comes when these trucks return and one of them is unable to find room enough to back into position. Sometimes the driver of the offending truck has gone home or cannot be found and another driver has to take care of his truck. Two or three trucks carelessly placed may make it necessary to move a whole row of compactly arranged machines, advancing and backing them again and again until the line is reestablished with the trucks in their proper stalls.

An Effective Method of Parking. One way of preventing this confusion is by painting broad white zone stripes on the garage floor, indicating the stall which each truck must occupy. A better method is to carry this idea a step further and provide raised guides in place of stripes. A truck can easily run over a painted stripe, but it will balk at a concrete rail four or five inches high. Figure 266 shows how one operator built these concrete stalls. Besides providing two parallel guide rails it is necessary to prevent the truck from straddling either one of them. Some truck owners fill up the space between the rails, making a concrete "island." It is only necessary of course to close up the front end. The front bar should be six or seven inches high, to prevent the trucks from running over it.

These concrete stalls should not be constructed until the exact location has been determined by experiments. The stalls indicated by painted stripes can be used for test purposes. Some-

times unusual conditions require a special arrangement of stalls. How one traffic manager solved the problem of arranging stalls in a narrow garage is explained in Figure 65.

A Buffalo contractor uses an original design for curbing to serve as a backstop for his trucks. The concrete back rail is molded in a concave curve, shaped to follow roughly the circumference of the rear tires. In many garages trucks are backed up against a rail with vertical side and sharp edge like a curbstone. This sharp edge may press deeply into the tire, and have the same effect as overloading it at that point.

Locating the Repair Shop. Questions relating to the repair shop, its size, the thoroughness with which it shall be equipped, and whether in fact the owner shall establish a repair shop at all, are decided by the number of trucks, the mechanical skill of the drivers, or of the truck owner himself or members of the firm. The business man must decide these preliminary matters before he starts out to buy a cent's worth of equipment.

If he operates but one truck and has a driver who is handy at repairs, he will find it worth while to provide a small kit of tools with which the driver can make small road repairs and minor adjustments. (Figure 267.) There is a big difference between such an outfit and the equipment of the American Express Company in New York operating a fleet of over a thousand motor trucks. Mr. Edward E. LaShum, who is General Superintendent of Motor Vehicle Equipment, describes a system of four garages in New York City, one of which has six service floors with a capacity for 350 gasoline trucks, in addition to which four other floors provide repair shop, paint shop, blacksmith and carpenter shop service, besides a complete heat-treating apparatus for the maintenance of the 650 vehicles in Greater New York. With such an enormous fleet of trucks it has been found advisable to install practically every known piece of equipment for the repair and rebuilding of motor trucks. In this garage trucks are actually rebuilt, even to the making of special parts which ordinarily are ordered from the truck manufacturer. It is size, however, which warrants such equipment, which would not be justified perhaps by even 200 trucks, although 200 trucks constitute a fleet which can only be described as huge.

Having determined the size of his repair shop by examining his own particular circumstances, the truck operator must fix upon its location. If his garage has more than one story, the

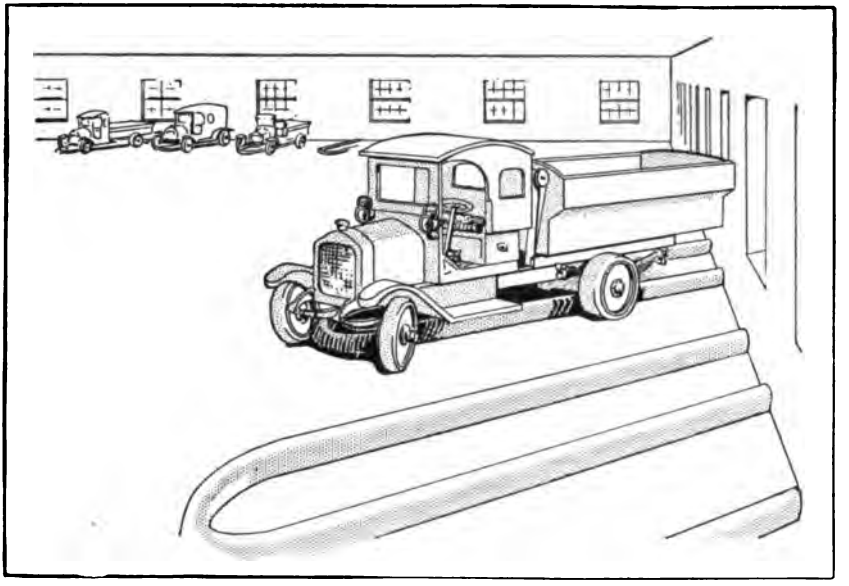


FIGURE 266: No need to say "move over" to any truck in this garage. The stalls are just wide enough for the trucks to straddle, and the location of every truck is fixed almost to an inch. This simple plan eliminates confusion.

FIGURE 267: This compact little box contains a kit of tools and a number of spare parts, enabling the man in charge of the truck to make many repairs without laying the truck up, which otherwise might frequently be neccessary.

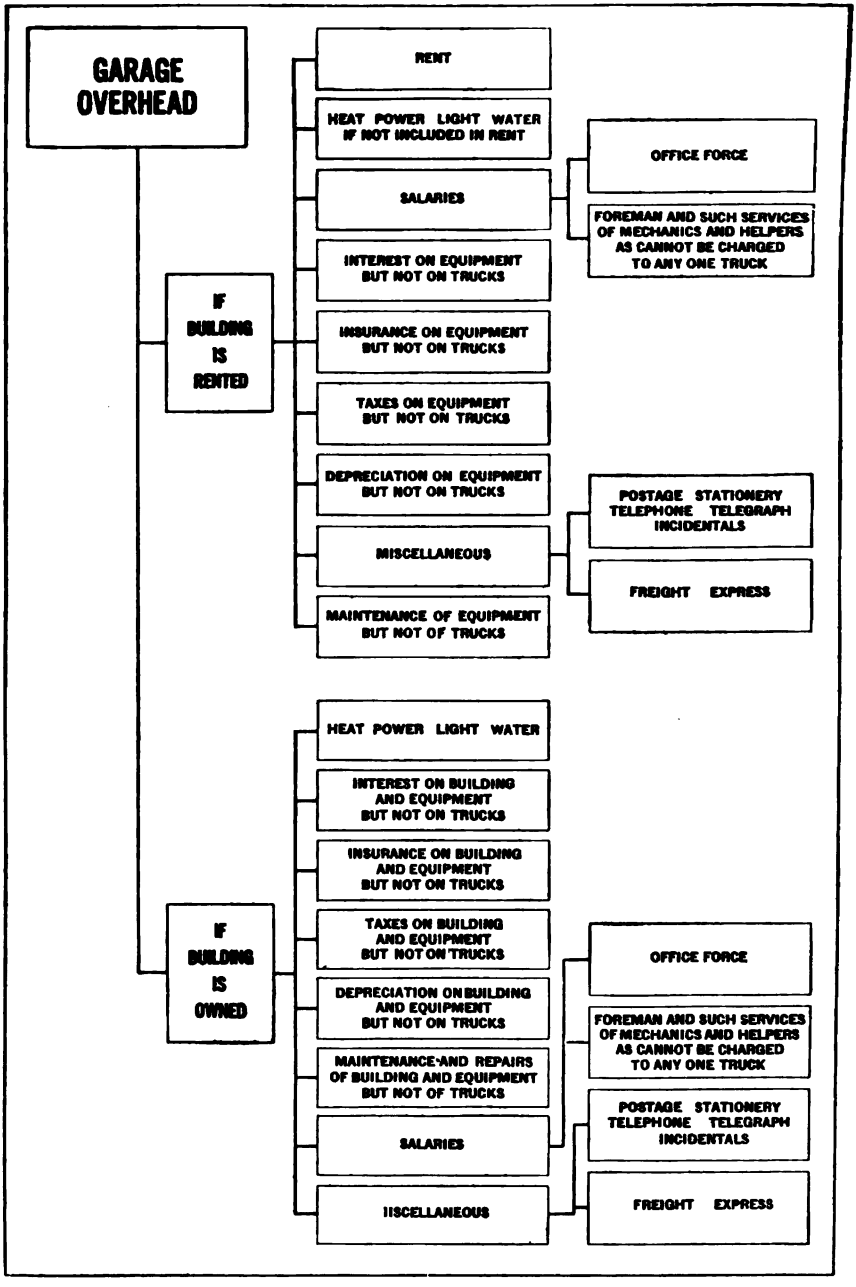

GARAGE OVERHEAD
IF BUILDING IS RENTED
RENT
HEAT POWER LIGHT WATER IF NOT INCLUDED IN RENT
SALARIES
OFFICE FORCE
FOREMAN AND SUCH SERVICES OF MECHANICS AND HELPERS AS CANNOT BE CHARGED TO ANY ONE TRUCK
INTEREST ON EQUIPMENT BUT NOT ON TRUCKS
INSURANCE ON EQUIPMENT BUT NOT ON TRUCKS
TAXES ON EQUIPMENT BUT NOT ON TRUCKS
DEPRECIATION ON EQUIPMENT BUT NOT ON TRUCKS
MISCELLANEOUS
POSTAGE STATIONERY TELEPHONE TELEGRAPH INCIDENTALS
FREIGHT EXPRESS
MAINTENANCE OF EQUIPMENT BUT NOT OF TRUCKS
IF BUILDING IS OWNED
HEAT POWER LIGHT WATER
INTEREST ON BUILDING AND EQUIPMENT BUT NOT ON TRUCKS
INSURANCE ON BUILDING AND EQUIPMENT BUT NOT ON TRUCKS
TAXES ON BUILDING AND EQUIPMENT BUT NOT ON TRUCKS
DEPRECIATION ON BUILDING AND EQUIPMENT BUT NOT ON TRUCKS
MAINTENANCE AND REPAIRS OF BUILDING AND EQUIPMENT BUT NOT OF TRUCKS
SALARIES
OFFICE FORCE
FOREMAN AND SUCH SERVICES OF MECHANICS AND HELPERS AS CANNOT BE CHARGED TO ANY ONE TRUCK
POSTAGE STATIONERY TELEPHONE TELEGRAPH INCIDENTALS
IISCELLANEOUS
FREIGHT EXPRESS

FIGURE 268: If you rent space in a public garage you receive invoices which enable you to charge each truck with the proper amount. But suppose you operate your own garage? Then you have to charge each truck with an equal share of the overhead expense. What is overhead? This chart tells you.

repair shop should be located on the top floor. There are two reasons for this. First is the necessity for all the light that can be obtained. Second, the repair shop must be removed from all other activities of the garage, if accurate, uninterrupted work is to be performed. If the garage is a one-story building, the repair shop should be located at one end, well beyond the paths of travel taken by the trucks. The repair shop breeds a confusion of its own, tools lie about it, and the circle of work spreads larger and larger round a job. The mechanics require space. They must not be crowded or jostled, or subjected to interruptions if good work is to be produced. Moreover, the space on the first floor is needed for trucks running in and out of the garage in normal service.

Importance of Garage Cleanliness. The garage that is not clean is not efficient. Consider for a moment the problem in the terms of congestion. We have in mind a building which houses a dozen trucks. There is plenty of room for the dozen, but not room enough for thirteen. When everything is in its place, the garage is a model of compact orderliness. But suppose one or two trucks are out of their place, blockading an aisle; suppose that a few tools are lying on the floor, a driver's overalls, an old tire, and a pile of rubbish, or a pool of oil. What was order has become confusion.

One truck owner solves the problem by estalishing a rule: "nothing on the floor." He provides shelves for clothes, plenty of cupboards for tools, and hooks and nails for tires, and "a place for everything and everything in its place."

Cleanliness can be aided by proper floor design. The garage of a large Akron rubber factory is provided with a floor which drains water and oil wherever it may lie. The floor does not have any general pitch or slant, but is as high at one side as at another. The surface, however, is shaped into scores of shallow scallops, hardly noticeable to the eye. Each scallop is provided with a floor drain. A special place is provided for washing trucks, where a more pronounced pitch is employed to carry off a great volume of water in a short time.

One merchant was faced with the problem of keeping track of tools. They were left about on the floor, lost, or stolen. He built a wooden cabinet with a hook or cleat for every tool. When the night shift went off, the night foreman was held responsible for the tools. If any were missing, either at night or in the morn-

ing, the various mechanics were questioned until the tool was located and put back in its proper place. This simple plan saved him some expense and prevented confusion.

Stopping Leaks in the Supply Room. A necessary adjunct to the garage is the supply room. Here are kept spare parts, repair material accessories and sometimes gasoline and oil. And here occur the most serious leaks in the operation of the garage. The mechanic comes to the supply room for parts and material. Sometimes he is in urgent need of a part, and takes it without waiting to notify the storekeeper. The driver in need of gasoline secures five gallons and leaves a scribbled memorandum which blows away or is lost. The helper drops in for an accessory, and a workman borrows a tool which he fails to return. At the close of business the inventory fails to check. Something has been lost, stolen, or carelessly thrown in a corner to rust or do more serious damage. It does not matter which.

Part Number or Symbol K 128 Bin Number 642

Description Name of Material R.H. Steering Knuckle Maximum Order 100 Minimum Stock 25

Date	Order Number	Requisition Number	In	Out	Stock on Hand	Date	Order Number	Requisition Number	In	Out	Stock on Hand
10/1					74						
10/5	840		100		174						
10/6		549		4	170						
10/10		715		75	95						
10/18		772		40	55						
		384		1	54						

FIGURE 269: This form is, in fact, a bin card. It records the number of units in any given bin. It assists the truck owner to keep an inventory of the material stocked in his garage and to charge both material and labor to the right truck.

How can the supply room be kept in order? First, it should be kept apart from other activities in the garage. It should be considered as a separate department, being charged with the goods it receives and charging other departments for goods which it delivers upon order. Second, its door should be locked and goods delivered only over a small counter. This prevents the garage workmen from helping themselves when the storekeeper happens to be away. Third, the parts should be arranged

according to numbered bins, and entered on stock cards, by which the goods and the bins can be checked at any time.

Perpetual Inventory Stock Cards. Figure 269 shows a simple stock card headed with the name or description of the part or material, together with its bin location. On the body of the card are spaces for the receipt of new material and the delivery of material already on hand. A perpetual balance is kept, material coming in being added to and articles going out being subtracted from the previous balance. This single card form constitutes the "books" of the stockkeeper.

The stockkeeper will not deliver material except upon receipt of a written order. The only order which he recognizes is that shown in Figure 270. This order has a requisition number, in this case 348, which identifies it. The stockkeeper, upon delivering the material called for, enters the withdrawal

Cash _____
Charge _____
Car Number _____
Job Number 3

STOCK ROOM
Requisition

Date 10/28/18
Number 348

Part Number or Symbol	Quantity	Description or Size	Names of Material	Bin Number		
K128	1	R.H	Steering Knuckle	642		
K621	1	2 "	Copper Exhaust Gasket	156		
		Car	190			

FIGURE 270: When a mechanic, in the garage where this form is in use, wants material, he doesn't simply "go and get it"; but fills out this requisition and surrenders it to the stockkeeper for the material. This keeps the stock in balance.

on the stock card with the requisition number of the order. Thus he not only keeps a check on the material going out, but identifies each withdrawal with the order which occasioned it.

Distributing Workmen's Time. Let us go back a step further and examine a third form. When a truck is put into the shop for repairs, it is given a job number. The work to be done is divided into several jobs, all bearing the same number, and different job tickets are made out in the office similar to

Figure 271. These job tickets go to the stock foreman, who distributes them to the different workmen. This method can be followed in any garage, no matter how large or small, and the simple form shown is adaptable to any sized plant. In a large garage the time section of the job ticket may be kept on individual time tickets instead of on the original job, and the material, similarly, may be kept on a separate order; but in a small or medium-sized shop both these items may be combined on a single card.

The job tickets are handled in detail in this way. A job ticket bearing the job number is given to each man who works on that particular order. Each fills in a description of the work he does and the time it takes. In large garages it is often worth while to use a time stamp and divide the ticket as has been suggested, so that time only is kept on the job ticket, but in the smaller plant this is not essential.

If new parts or materials of any kind are needed, the foreman makes out an order, Figure 270, which we have already described. When the job is complete, the foreman collects all time cards bearing this job number, and sends them, together with duplicate orders for materials used, to the office. This gives the office all the needed information to figure the total cost of the job, with the exception of overhead charges, which will be explained later.

Keeping Enough Stock on Hand. When goods are ordered from suppliers, one duplicate of the order is held in the office, and the other is sent to the stockkeeper who holds it until the new goods are delivered into the stock room. When the goods are delivered he notes on Figure 269 the date of such delivery, the order number and quantity in the "in" column, stamps the order "Received O. K." and returns it to the office where it is filed by number with the original copy and where it must be received before the bill is paid.

Whenever a requisition is presented to the storekeeper, he notes on Figure 269 the date, requisition number and quantity in the "out" columns of the correct inventory card. In this way, any item removed from the stock room can readily be traced to its destination. After goods are received or given out, the total stock on hand is extended in the "stock on hand" column. Obviously, the lowest figure in this column always represents the quantity on hand. By fixing the maximum and minimum quan-

tity to be ordered in the "maximum and minimum" column, another item of routine is made almost automatic, for, at a glance the stockkeeper can tell by comparing the lowest figure in the "stock on hand" column with the figure after "minimum," whether it is time to order a new supply of goods; from the "maximum" figure he determines how large the order should be.

Amount 284	Name J. W. Wilson		Date Nov. 20				
Job Number	3 Kind of work		Hours	Minutes	Overtime	Out	
	Line up Wheels		1	30		In	
	R. H. Steering Knuckle			50	Afternoon	Out	
						In	
						Out	
					Morning	In	
O. K. by H. K. Northton Foreman		Total Time	2	20			

FIGURE 271: In the garage where this form is used, no new job is started without first presenting this form, properly filled out. All information about the job is noted on the card, which finally goes to the accounts department.

A Garage Accounting System. One thing more remains to be explained; the relation of the garage accounts to the general truck accounting system. If the owner rents space in a public garage he will receive at the end of the month three kinds of bills:

1. Supplies (gas and oil)
2. Repairs
3. Storage (including washing, polishing, and other care)

He must, therefore, so order his garage accounts that he can charge each truck with these items in the proper proportion. This system shows how supplies and repairs can be kept separate for each truck. But what does storage represent?

Briefly, storage represents overhead, that is, all expenses of maintaining the garage which cannot be charged against any one truck, but must be shared by all. These items of expense are shown in Figure 268.

PART V

PRESENT TASKS AND FUTURE PROBLEMS

CHAPTER XXV

USING MOTOR TRUCKS TO INCREASE PROFITS

GENERALLY speaking, a merchant is effective only as far as he can reach. Where wheels will go and return the same day is his territory. Beyond this is the territory of someone else.

If the merchant depends entirely on horse delivery, this circle is sharply limited by a radius of ten miles, for it is universal testimony that the average team cannot with regularity and profit cover more than twenty miles a day. If he makes use of the motor truck the radius of this circle of effectiveness is increased to anywhere from fifty, or sixty, or even, under certain conditions, to seventy miles.

Many a business is so situated with respect to its productive power that it could expand indefinitely if means could be devised for delivering its increased output in a satisfactory and economical manner. In the past the horse has placed a heavy check on growth, and business houses which have expanded have been obliged to establish branch stores or sacrifice a share of the profits by handling their output through dealers and agents. Many business men would doubtless do well to count the cost of various systems of delivery, and consider whether their present system is the most economical; and whether—if it is not—they can afford to try out trucks, which may cost more to purchase but frequently prove the cheapest in the long run, provided that the conditions are right.

How Trucks Expanded One Business. In Philadelphia a few years ago, a provision merchant, now well known, was operating in a small way within the city limits. He had seven horses and wagons and delivered goods to grocery and provision stores along well-arranged routes. He figured that for the work in hand horses were more satisfactory than trucks. In this he

was correct, as the stops were frequent and the distance covered daily by each team was less than twenty miles.

His attention, however, was drawn to the rich outlying territory near Philadelphia, the towns and cities lying beyond the suburbs, such as Princeton, Trenton, and Doylestown on the north, Coatesville and West Chester to the west, and Bridgeton and Williamstown over in Jersey. These towns were served, and served poorly, by slow-going boats plying the Delaware, and also by rail. Provisions were shipped to only the principal points along the railroads and the waterways, and jobbed from those points. This was unsatisfactory, as orders were placed only at intervals by the local provision men, and the tendency was to order less, rather than more, than needed.

Moreover, after the stocks were laid down at the wharves and railway docks, the real problem of distribution still remained unanswered. No dependable system was in use for distributing these stocks to the small towns in the district.

The problem looked interesting to the provision merchant. Having briefly analyzed it, he called into play a higher faculty, creative imagination, and began to picture in his mind how the situation might be changed with motor trucks.

He imagined a fleet of fast trucks covering this territory daily, or at intervals of two or three days. He estimated the effect on this trade of a regular, dependable running schedule, with frequent calls, especially in towns distant from points on the rail and water routes. He took into account the reduced expense of handling business of this type due to the elimination of three separate handlings of stock, the cutting out of the dealer's commission, and the further expense of branch stores. He also considered the prestige which he, as a city merchant, would have, and the "fresh-stock-at-city-prices" argument.

Mapping the Expanded Territory. At about this time he called upon the local branch of one of the best known truck manufacturers in the country for advice. A salesman conferred with him. They prepared a map of the territory under consideration, which in its final form is reproduced in Figure 272.

The territory itself suggested a division into zones or loops. Loops numbered one and four measured about 75 miles, taking into consideration several offshoots to small towns along the way. Loops two, three, and five took anywhere from 120 to 140 miles to cover.

He bought five trucks. For the loop to West Chester and Coatesville and the trip to Burlington and Mt. Holly, he purchased a couple of 1,500-pound trucks equipped with pneumatic tires. These trucks were speedy, and able to make the trip of 70 odd miles before sundown. As they carried only enough stock for a day's deliveries, their capacity was ample.

The three remaining loops were too long to be done in one day's running with proper attention to necessary calls. The provision merchant allowed two days' time for each of these routes, the trucks spending the nights always at the same half way points, where economical arrangements were made for housing trucks and drivers. As these trucks delivered twice as much as those on loops one and four, he selected three one-and-a-half-ton models.

The increased weight made it seem a questionable policy to equip with pneumatic tires, and, inasmuch as the distance per day was considerably under that covered in the shorter routes, and the number of calls per mile was also less, he found that he could reduce the speed on the larger trucks and use solid tires.

Creating a $200,000 Business. As a result of this system, he created a business running into $200,000 a year. The plan worked better than he had hoped. The regular, frequent deliveries, and the absence of real competition, the prestige of the city store, the guarantee of fresh goods, the psychology of the trucks themselves—all of these factors brought business to him. Instead of quoting lower prices on account of the economies resulting from motor delivery, he soon found that he was able to charge higher prices because of the greatly improved service.

At the present time he no longer has the field to himself. Competitors have bought trucks that keep pace with his. They are profiting indeed by his example. In the meantime, his trade building argument takes on a sterner aspect. What was once an opportunity has become a necessity.

The Law of Increased Returns. The merchant who seeks larger territory by the aid of the motor truck can call a geometrical principle to his aid. Roughly speaking, this principle is stated as follows: "Twice the Radius—Four Times the Area." Let us suppose that Matthews has a horse and wagon with which he covers a piece of territory which extends in its longest direction about eight miles from home. This territory can be represented by a segment of a circle, and everything inside the

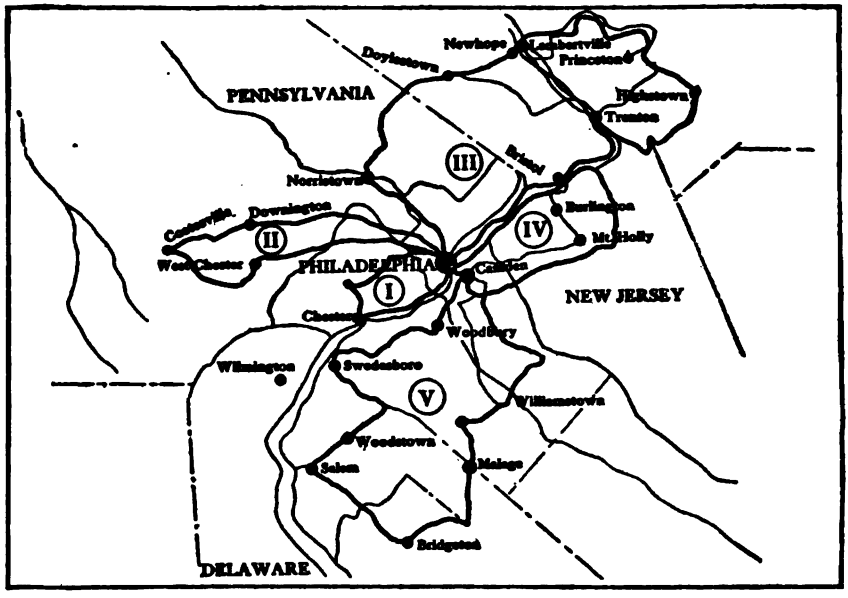


FIGURE 272: Two hundred thousand dollars' worth of business awaited the grocer who could find the means for coming after it in this rich territory. Fast trucks, over these five routes, brought it to a Philadelphia merchant.

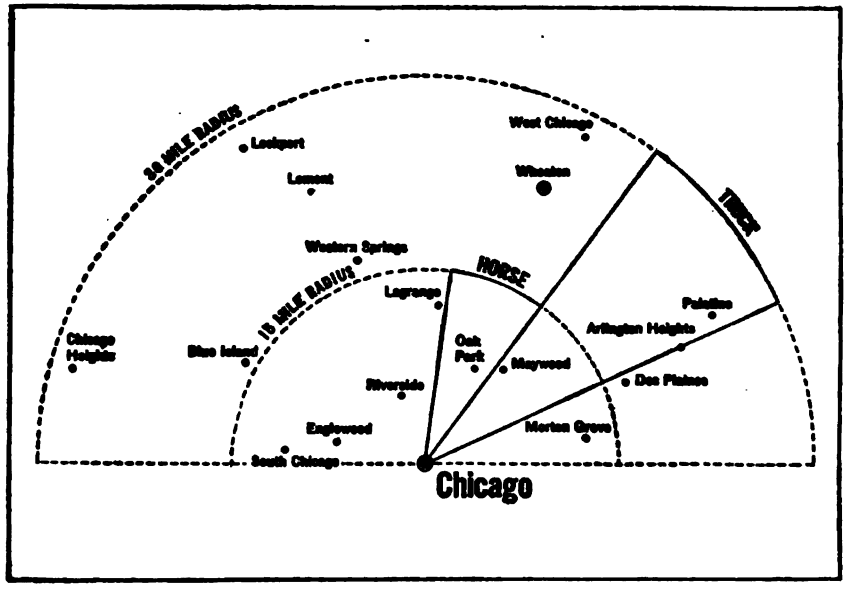


FIGURE 273: This chart shows how by using a motor truck a merchant may constantly extend his business into more productive territory. Mathematically speaking, a truck quadruples his territory every time the radius is doubled.

boundaries is served by Matthews' horse and wagon, either by direct call or distribution through agents. Matthews' round trip is about 20 miles, which he finds is all his horse has strength or time to do. (Figure 273.)

Hawkins, on the other hand, has bought a motor truck with which he finds that he can easily cover twice the distance that Matthews can. This slice of territory extends sixteen miles from home. But in getting twice the distance he covers an area four times as great as that reached by Matthews. He has quadrupled his market. Thus, as the motor truck goes farther and farther afield, it opens up new territory constantly richer and larger and more productive.

Reaching out for Bigger Business. A striking example of the practical working out of this theory is afforded by the experience of a coal company in Long Island City. When this company had teams, it was unable to deliver coal profitably at a distance greater than three miles from its yards. Outside of this three-mile circle was a field so big that the proprietor grew uneasy thinking about it.

But this was back in 1908 and 1909, when the motor truck was very much in its infancy, and before the business man had begun to think of the possibility of doing business further away than teams and wagons could go.

Nevertheless, the owner could not help thinking of this large field which he could not reach. In this field he saw a bigger firm and bigger profits. Bigger profits meant that he could afford to install labor-saving machinery in his coal yards, such as loading devices, and other coal-handling machinery, and this equipment, by cutting costs, would again increase his profits. With improved equipment and larger margins of profit, he pictured more and better deliveries, and an increasing number of satisfied customers.

But how could he reach this larger territory? He had no room for extra horses with their wagons and equipment. Moreover, he felt that they could not make a longer distance profitably. Establishing branch stations would be simply a case of duplicating his present business over again. It would mean increased business, but the expense in getting it would bear the same proportion as in the case of his present situation.

In 1912 this concern bought one motor truck and put it to work on a route going east from Long Island City. The truck

did not stop at the three-mile limit, but went on to a distance of over twelve miles. The area of territory reached jumped from three and one-half square miles to over fifty! Four times the distance—sixteen times the area. This was but the beginning of a period of expansion which has already enabled this company to sell over 100,000 tons of coal a year.

By reason of the increased business and profits, it became practicable to invest $10,000 in coal barges, which cut the cost of getting the coal to the company by thirty cents a ton. More thousands were spent on a steam-hoisting apparatus and a 3,000-ton coal pocket, with three driveways and thirty-six coal chutes, each provided with automatic cleaning screens. A new steam shovel equipment was installed, automatic conveying systems, and other equipment which goes only with a large coal yard.

This tremendous expansion and growth which transformed a dealer in coal by the bushel to a concern selling upwards of 100,000 tons a year was due first of all to an increase in number of customers. But this was brought about only by an increase of territory, and this in turn was made possible only by a new means of transportation, because it had been demonstrated before that, while horses might cover additional territory, they could not cover it profitably. The thing needed was a new agency in transportation having greater speed and greater strength than the horse—in other words, the motor truck.

A well-known dairy concern in the East up to a very few years ago used horses exclusively. As a result it was greatly restricted in its radius of activity. Not only was horse delivery limited to a distance of ten miles, but, a still more serious consideration, it was very slow. For various reasons, milk must be handled with dispatch. Not only must it be kept fresh, which in itself is a matter of some expense, but it must be delivered early and at frequent intervals. It cannot be "stocked."

The Truck as a Sanitary Agent. The dairy company installed a fleet of eight five-ton trucks. Formerly its milk was hauled in large wagons drawn by four hourses. It was found that each motor truck was able to replace four wagons, or sixteen horses. This was due not only to the superior speed of the truck, but to the fact also that it could be used day and night. Previously it had been necessary to use two shifts of horses.

Because of the increased radius of its new delivery system, the dairy concern was able to establish four branch depots. The

trucks were used to transport the milk to these depots, to be delivered to customers by teams. As a result of the establishment of these new branches made possible by the trucks, the business has increased in a short time over 100%.

But an additional advantage followed the use of trucks. Milk is perhaps more easily contaminated by uncleanliness of all sorts than any other article of food. This fact has been explained so thoroughly by articles, newspaper editorials, and other agencies, that it has become part of the public consciousness, and requires but little emphasis on the part of the dairy company itself. (Figure 281.)

Stables, with their sometimes attendant filth, may become sources of contamination. Moreover, whatever measures may be taken by dairy concerns to separate the operation of the stables from the operation of dairies, the mere fact that horses are used in connection with a dairy is perhaps repugnant to some, and frequently results in a loss of business where competition comes from a concern using trucks. The motor truck is comparatively clean. This dairy establishment early recognized this advantage attached to its truck installation, and made capital of it in its advertising. This was in addition to the advertising of a general nature which it got from its trucks.

So much for examples to prove the usefulness of the truck as a trade builder. Now let us take an example of how the truck can make an "impossible" line of business "possible" from another field.

The Truck as a Suburban Trade Winner. A prominent coal dealer in Philadelphia went over his books three years ago with a view to finding out how he stood with past customers. To his surprise, he discovered that a great many names formerly on his ledgers were now missing. The mystery was cleared up by further examination, however, for he found that in nearly every instance the former customer had moved to one of the suburbs and was buying coal locally. This coal dealer had never ventured beyond the city limits in soliciting business.

The situation set him thinking. Trucks had been called to his attention several times, but he had put them aside with the argument that he had to contend with short hauls where trucks would not show savings over horses. He now looked at the motor truck in a new light. He saw in it a possible means of extending his reach and recovering the valuable business which

he had lost by reason of the limited radius of the horse delivery system he had been using.

By telephone and by letter he got in touch with all his former customers who were still alive and in the vicinity. For the most part, they remembered pleasantly the dealings they had had with him, and fully 90% signified their willingness to buy coal of him again if he could compete in price and delivery with the local dealers. It was a problem in creative sales policy. The coal dealer bought three two-ton trucks, and later increased this number to five. By this means, he won back most of his old customers, secured new ones, and enlarged his business 60%.

Trucks Revolutionized this Business. Consider an example from another field. A prominent transfer and contracting company in Flatbush, New York, owned one hundred and ten mules in 1911. That year it purchased a five-ton truck of a well-known make. This truck was bought "against instinct." It was a concession made to the persistent and, for the most part, unanswered argument of a well-informed truck salesman. In 1911 it was harder work to sell a truck than today.

After experimenting a little with the truck, the company discovered that on hauls where eight yards of gravel a day was good work for a team, from forty to forty-eight yards could be handled with a five-ton truck. This difference was increased in cases where steep inclines were encountered, either on the road or, as often happens, at the scene of delivering the material. Under such circumstances, it was necessary, with mules, to hitch on an extra team. This caused delay, as well as the tying up of one or more extra pair of mules.

At about this time bids were being opened for subway work in Brooklyn. Up to then the business of this company had been confined to a radius well under ten miles. It had always hesitated about undertaking jobs beyond this radius.

Having thoroughly experimented, however, with its five-ton unit, it was in a position to base its bid upon a reasonable expectation of motor truck performance. Not only had it proved the economy of the motor truck in competition with mule teams, but it found that in this case it would easily be able to operate from its home plant as a base, while with mules it would be necessary to move the animals and some of the stables and equipment to Brooklyn—an expensive and troublesome proceeding, to say the least.

Armed with this information, the company made a close bid, and, to the surprise of contractors located in the immediate vicinity of the subway work, secured a large part of the contract. It at once ordered three more five-ton units of the same make, and, with only a few mules used for short hauling and for dragging scrapers, it performed this, its biggest job, in record time.

This was a revelation to the company, and it began at once a systematic policy of replacing mules with motor trucks. At present this company owns just four mules. It is no longer bounded by the ten mile horizon. While its business increased 50 %, its housing problem has decreased over 100%. Stables became warehouses, contributing profit instead of expense.

A Record Performance. Recently one of this concern's five-ton trucks made a trip to Ramapole, New Jersey, for a capacity load of frogs and switches for the Intercontinental Railway. The start was made at 6 o'clock in the morning, and the round trip of 95 miles was completed by 5 o'clock that afternoon. It would take three teams two days to do this work.

Shortly after the Brooklyn subway contract was allotted, bids were opened for the construction of the aqueduct. The bids called for the delivery of 115,000 barrels of cement, and specified 1,000 barrels per day. This concern performed the work with four trucks. They carried 110 bags to a truckload. By means of a special gasoline hoist this load was taken from the boat and deposited in the truck in six minutes, and the same amount of time was consumed in unloading.

Delivering Bread 40 Miles. Years ago nobody would have thought that a baker would drive 40 miles to deliver bread. A Philadelphia baking concern, however, serves thousands of persons in outlying sections by means of four 2-ton trucks.

Two of these trucks average 98 miles every week day and another averages 97 miles. The fourth makes 76 miles which is rather small compared with the distances covered by the other three, but which is a very high total to be maintained daily. In one month one of the trucks will average 2,470 miles covered, 780 stops made and 117,000 loaves delivered.

What made this tremendous expansion of business possible? Let us consider the following problem: If it were possible for this baking company to get fresh bread into the various little shops by the time they opened for business at 6 o'clock in the morning, this business would be theirs for the taking. Nearly

everybody likes fresh bread for breakfast. But the express company could not guarantee any certain delivery. Occasionally the expressman would be on time, but just as likely he would be late. When it comes to delivering bread for breakfast, a miss is as good as a mile, and bread that comes an hour late might as well not come at all. But the trucks were operated on a schedule, They had nothing else to do but deliver bread. They succeeded. and this immense amount of business was created out of nothing, so to speak, for the baking company.

How the details of the various route schedules are made out, is given specifically in the following table:

TRUCK No. 1. DISTANCE COVERED 76 MILES

LV.	Philadelphia	2:00 AM
	Darby	
	Sharon Hill	
	Lansdowne	
	Norwood	
	Ridley Park	
	Moores	
	Chester	
	Wilmington, Delaware	
	And return to Philadelphia at	12:00 M

TRUCK No. 2. DISTANCE COVERED 98 MILES

LV.	Philadelphia	2:00 AM
	Cynwyd	
	Narberth	
	Ardmore	
	Bryn Mawr	
	Malvern	
	Paoli	
	West Chester	
	East Downington	
	Downing	
	Coatesville	
	And return to Philadelphia at	12:00 M

TRUCK No. 3. DISTANCE COVERED 97 MILES

LV.	Philadelphia	2:00 AM
	Palmyra	
	Riverside	
	Beverly	
	Columbus	
	Bordentown	
	Trenton, N. J.	
	And return to Philadelphia at	12:00 M

CHAPTER XXVI

HOW THE TRUCK CAN HELP YOU MEET COMPETITION

THE motor truck, bearing a load which is often many times as heavy as that which the horse can haul, and carrying it many times as fast, has already performed prodigies in the field of transportation. It has proved its adaptability in a hundred different kinds of business.

But the motor truck is more than a carrier: The keen business man sees in it also an instrument of competition. For transportation is a very real element in the selling price of merchandise, and a merchant who can haul his goods more cheaply than a competitor may be able to lower the price of his wares by a critical cent or half-cent which may mean taking over of a considerable amount of business from another concern.

With the introduction of motor trucks into so many different kinds of business, the merchant cannot face this matter so complacently as before. "This truck will haul three tons and go fifteen miles an hour," says the truck salesman, "and that is more than you can do with five horses and wagons." "Very good," says the merchant, "but I guess I won't buy today." "But Hawkins on Twelfth Street has just bought a truck and is coming over here on the West Side and getting your business away from you." "You don't say," replies the merchant in alarm, "I will look into that at once."

Beating Down Competition. It is something more than the question of changing the type of delivery equipment. It is a matter of defending one's business from the attacks of a competitor—and the weapon used is the motor truck. The chief construction engineer of a big oil company recently said:

"We have five hundred trucks in round numbers Seven years ago we had two. Of the five hundred we now have, four hundred were added since 1915. This year, well, it depends on the calls we get for reenforcements.

"How did we happen to determine upon such an extensive truck installation? Did we find that motor trucks do the same work as horses at less expense in dollars and cents?

"That, of course, would be a good bookkeeper's reason. No doubt, we have among our records some analyses of the relative cost of trucks versus teams. These can be figured out fairly accurately. But the main thing is that we sometimes get letters like this from our branches:

" 'The Beekman Company has just installed a truck. As a result they are able to get to Plainville, twenty miles away, by 9 a. m. We couldn't do it with our teams if we started at 4 in the morning. We are going to lose Plainville if you don't send us a truck, and we want the Plainville business.' We generally send the truck.

"It probably would have been possible, by taking pencil and paper, to figure the cost of the trip to Plainville by motor truck and balance it against the expense, already known, of our team delivery. But suppose we had lost Plainville! The consequences might have been more serious to us than the loss of all our ledgers."

This chief engineer, in telling these facts, picked up a letter which had just been typed by his stenographer. He continued:

"In Jonesville, just out of Smith Forks, we built three years ago a six-horse stable, and beside it a small garage for one truck. The garage today accommodates one horse. In the stable are six trucks. This letter which I have in my hand contains instructions to remove the old wooden stable and build a modern concrete garage in its place.

"The experience of our company with motor trucks has extended over six years. If this experience has proved anything, it has proved that the motor truck is more than a mere carrier of merchandise. It is certainly a narrow point of view to judge a motor truck by nothing except the formula of 'ton-mile costs.' That judgment begins and ends at the accountant's desk. The other question it leaves unanswered: 'What if we had lost Plainville?'

"Our plan is to hurry a truck to a point where it is needed. To make sure that we can send trucks when the call comes, we keep a standing order of from 150 to 200 trucks with a well-known manufacturer. These trucks are our reserves, stationed somewhere in the background to be thrown into some part of the field of action at a moment's notice. They must be ready for the call. If the haul is somewhere near 15 or 20 miles, we don't consult the bookkeeper. We send the truck, for if we didn't someone else would get the business."

What is "Long Distance"? So much for this man's experience. Other concerns have similarly found it important, even aside from considerations of cost, to add motor trucks to their delivery equipment. Railroads as a rule have been considered unapproachable as a means for hauling merchandise long distances over land. But it is necessary to ask: "What is a long distance?" The distance between Milwaukee and Chicago is 85 miles. Is that a long distance? The freight rate is very low,

FIGURE 274: Something more than mere "hauling economy" is behind this truck. Service is the all-important consideration. In businesses, if you cannot deliver on time you don't get the business at all. But if you can, the story is different.

FIGURE 275: This fleet of trucks is used almost exclusively for moving household goods over long hauls. It travels into four states. The high van bodies are especially designed for furniture or other bulky shipments.

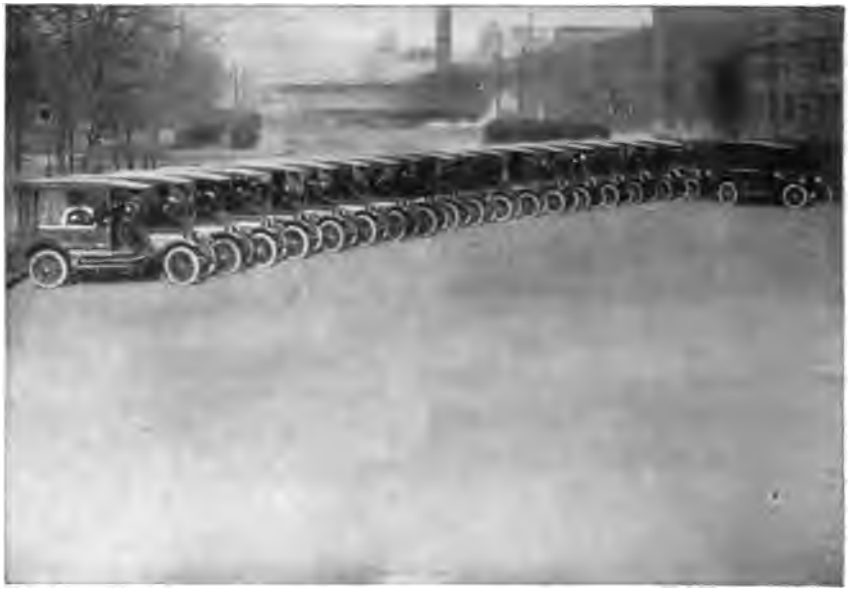


FIGURE 276: "News" is a commodity which has weight and size, and it is "perishable" as well. These 28 fast delivery cars suddenly put an eastern newspaper in a position of great advantage with respect to its competitors.

FIGURE 277: This speedy motor truck carries asphalt many miles with but little reduction of heat. When it arrives on the job, it not only dumps it in less than a minute's time, but also helps distribute it, which is a great advantage.

FIGURE 278: This heavy body was built especially to carry the standard size tin cracker cans. Both sides, the rear and even the roof are utilized for this purpose. A stationary ladder in the rear affords easy access to the roof.

FIGURE 279: This special body does more than carry a capacity load of ice cream buckets—it displays them to view. Many progressive merchants have availed themselves of this combination of utility and advertising value.

Crating	Crating the furniture of an 8-room house costs about $100. It is in most cases by far the largest item of expense in moving by rail. It is eliminated by motor truck haulage, where heavy blankets are used instead
Hauling to Freight Station	This costs generally $5 per load, and is eliminated in motor truck haulage
Freight	The freight charge itself is a small part of the expense of moving by rail
Hauling from Freight Station to Destination	This costs generally $5 per load, and is eliminated in moving by motor truck
Uncrating	A small expense, but eliminated in moving by motor truck
Hotel Expenses	Families must have some place to live; while they are waiting for freight to arrive, hotel bills mount up
Time	Delay not only causes expense; it is often a hardship as well
Division of Responsibility	In case of breakage three carriers are involved; only one by motor truck

FIGURE 280: Here you have in chart form, an expense bill for moving household goods by freight. With this before you, it is not difficult to understand why motor trucks are today successfully competing with railroads even on hauls of 200 and 300 miles. Instances are on record where they reduced the expense 50%.

being 37½ cents a hundred for household effects. Yet motor trucks regularly make the trip in competition with rail. In Philadelphia, an enterprising transfer company located on North Broad Street owns eight trucks of two well-known makes. With these trucks the company competes against the railroads regularly to points as far away as Washington, D. C.; Bridgeport, Connecticut; Harrisburg, Pennsylvania; and Dover, Delaware.

The Philadelphia concern is not only able to compete in price with the railroads up to a hundred miles; it has even exceeded that distance. Not long ago one of the 5-ton trucks made a trip from Philadelphia to New Bedford, Massachusetts, the round trip taking five days and the speedometer showing a distance covered of 710 miles.

Besides the feature of economy, the matter of time is often of great importance. People who move to distant places often have their arrangements already made in advance for their new residence. To wait upon the course of freight delivery, anywhere from four days to two or three weeks, is a hardship as well as an expense (Figure 280), and on that account alone this transfer company has been able to compete against the railroads even when its charge was the higher of the two.

Old Employees Make Best Drivers. This concern, by the way, has found that the best chauffeurs are the old and trusted employees, brought up as teamsters and educated in their special line of work. On the 3- and 5-ton units, the crew consists of the chauffeur, two helpers and a loader, except when using the trucks for city work, at which time one or two more men are added as conditions require.

Before a man is permitted to take charge of a truck, he must have served as a loader or helper for some time, and must also have a good knowledge of the territory and road conditions, Lastly, he is trained by an experienced chauffeur and mechanic. not necessarily in their employ, in the actual control and care of the truck.

Meeting Newspaper Competition with Trucks. Not long ago a newspaper in an eastern city bought at one time a fleet of 18 trucks. (Figure 276.) Of all enterprises, a newspaper depends more than any other on speed for successful operation. The expedition with which news is gathered and put into print is familiar to everyone. There is a very pretty little race, however, which takes place immediately after an

edition comes off the presses. This race is to supply the thousand and one dealers and agencies with copies of the latest edition.

For delivery outside the city all papers are more or less in the same boat, for it is generally a question of making a certain train, and as trains leave at various times, not much can be done except to make one or two deliveries in quantity at the station. Within the limits of Philadelphia, however, circling 129 square miles, there are about as many opportunities to get ahead of a competitor as there are dealers and agents.

First, there is the chance to deliver before a competitor. The paper which delivers its afternoon edition to the newsdealers ahead of its rivals gains just so much time in disposing of its copies without competition. The rivals cannot reply by advancing the time of issuing their papers, for by so doing they may sacrifice some of the freshness of their news. This invites the worst kind of disaster, for it may appear that they are continually being "scooped" by a rival. Moreover, the newspaper reader of today can distinguish a real last edition from a bogus one. Baseball scores and racing results tell the time of day almost as accurately as did the old sundial.

The newspaper in question did not long enjoy its unusual advantage. A rival paper responded by buying a fleet of 28 light and speedy delivery cars. The first purchase was certainly an excellent opportunity; was the second one a necessity?

Trucks as an Aid to Paving Contractors. Let us refer to another interesting example. A paving contractor in a large eastern city has been able to replace on an average five two-horse teams for each 5-ton truck which he has installed. The economies gained by the new system have enabled him to underbid competitors successfully against operators located at a distance who were formerly secure in their field. (Figure 277.)

Paving with asphalt is a business surrounded by conditions peculiar to itself. Briefly, these conditions are as follows:

1. Asphalt mixture must be delivered at a temperature between 280° and 350° Fahrenheit;
2. Asphalt must be delivered on schedule time, so that it can be used as soon as it is dumped;
3. An asphalt plant is a stationary proposition. As it cannot easily be picked up and moved, additional plants must be set up along the route if the distance is too great.

The contractor carefully considered how he could meet these nditions. His business, secured by bids in open competition,

depended in the last analysis on the critical factor of costs. If he could reduce the expense of hauling his asphalt, he could lower his bids correspondingly.

He finally decided to install motor trucks. With the truck installation he attacked the conditions of his business as noted above with highly successful results. Repeated in the same order as his problem has been stated, this was the answer which he made with motor trucks:

1. He was able to deliver his asphalt at a higher temperature than with teams at three times the distance by reason of the speed of his trucks. Moreover, he found it profitable to construct special bodies designed to retain the heat of the mixture. These bodies were built of a layer of wood, lined with steel, and with a layer of asbestos in between to retain the heat. Such bodies were rather expensive and would not have proved profitable on wagons, four or five of which would have been required to do the work of one truck.

2. He was able to deliver his asphalt on a schedule figured almost to the minute. This was of considerable advantage, as with teams it had always been guesswork, and they generally arrived too early or too late; in the former case the asphalt had a chance to cool; in the latter case the workmen cooled, at the contractor's expense. In addition, better paving was laid down, due to the uniformity of the mixture and the regularity with which it was supplied.

3. A most important economy was effected by eliminating the various asphalt plants which it had been necessary to set up along the road. Thereafter one large central plant was sufficient to supply all jobs, and, in addition, the radius of operations was considerably increased.

These three economies were of considerable importance. It should be noted, however, that they were in a way incidental to the fundamental economy of the motor truck as an effective carrier. Thus, it is not true of every business that loads must be carried speedily to prevent loss of heat, nor that deliveries must be made on schedule time, nor that a producing plant of a stationary character has to be reckoned with. But other lines of business, while lacking these characteristics, often possess others which are of equal importance.

Other Ways Trucks Help. The case of the asphalt contractor is a typical example of the manner in which a business can be aided in more than one way by motor trucks. But there are many other ways in which the edge of competition can be sharpened by the use of trucks. Thus, a produce dealer hauling perishable goods secures business by delivering fruit and vegetables while they are still fresh; a dairy profits by cleanliness (Figure 281); a baker must deliver his buns while they are hot; a mover gains prestige (Figure 282); a druggist gets advertising;

a newspaper promptness; a merchant increases his scope of business, and, by cutting down the proportion of expense to sales, is enabled to offer lower prices than a competitor.

In addition to all these advantages, which result in profit one way or another, there remains still the basic formula of motor truck efficiency—Speed × Load = Work, in which both speed and load exceed that of the horse and wagon. The asphalt contractor enjoyed this advantage also. For instance, he said:

"On a 9-mile haul, which is the limit of teams, it is two and one half times more expensive to operate teams than trucks. Beyond 9 miles (18 miles for the round trip), the team cannot go at all."

Failure Due to Lack of Motor Delivery. The next example is taken from the experience of a small merchant. It presents the obverse of the medal, that is, the case of a business man who was forced out of business by his failure to appreciate properly the value, and as it happened, the actual necessity of availing himself of the superior services of the motor truck.

The retailer was a butcher in a city of some 75,000 inhabitants. His equipment consisted of one horse and wagon, with which he made the rounds of a certain residential district, selling meat. He was an elderly man, but well liked, and originally enjoyed a monopoly of the business in the territory which he covered and considered his business immune from competition.

In time, however, a firm of competitors appeared and as they were new in the business and not handicapped with horse-drawn equipment, they provided themselves with motor trucks as a matter of course. It was not long before the old meat dealer began to feel the effects of this competition.

His competitors not only called earlier in the morning, but were able to make more than one call a day; were willing, in fact, to make special trips at short notice to serve their customers. The old-established butcher limited his deliveries to one trip a day. Although he was well liked by his customers who, if anything, would have preferred to continue their satisfactory dealings with him rather than to start with a new dealer, his competitors gradually worked in and took several of his regular customers away from him.

The butcher's friends suggested that his delivery equipment was at fault. He was unwilling to accept this explanation at first, for he had been used to horses all his life and up to the present had been getting satisfactory results from his horse and

FIGURE 281: Milk must be kept clean and delivered with speed according to a predetermined schedule. Motor trucks are well adapted to meet these conditions. They are sanitary, speedy, and generally far more reliable than horses.

FIGURE 282: When household goods are moved by motor truck, both the householder and the furniture mover are better satisfied. They are safer, more economical and generally accomplish the task in far less time.

FIGURE 283: This battery of swift delivery cars enabled a city store to reach 38 miles into the suburbs and sell goods in competition with the local stores. This is a phase of commercial competition, which did not exist 10 years ago.

FIGURE 284: No maneuvering to deliver here! Up the incline, a few seconds to dump the load and the truck continues down the other side. It paid to figure this out, for a truck's time is too valuable to waste even three minutes unloading.

wagon. Finally, however, the situation became so bad that, as a last resort, he decided to buy a truck.

He bought a second-hand truck at a very low price and made his young counter man the driver. The latter, entirely unfamiliar with the management of a motor truck, and given charge of a machine that was practically worn out, encountered serious difficulties. The truck broke down, necessitating expensive and almost endless repairs. Moreover, the driver, who was unskilled and reckless, figured in two or three accidents, which, though not serious, were more or less expensive. The meat dealer finally gave up the experiment, convinced in his mind that the motor truck was a failure, at least in his business. In his own mind he was satisfied that he had given the motor truck a fair chance to make good.

His customers soon became familiar with and accustomed to the prompt and efficient service of his motor truck service and were unwilling to go back to the old horse and wagon delivery. His competitors, calling earlier and oftener, and bringing with them the subtle appeal of modern methods, took over his customers by twos and threes, and in the course of a year's time the familiar horse and wagon were no longer seen on the accustomed route. The meat dealer was actually forced out of business. Of course, this case may be a bit exceptional, but it shows the possible advantages that may be secured by the use of motor trucks.

Winning the Suburban Trade. At the other end of the scale from the small butcher is the competition which the large metropolitan stores are constantly bringing to the local dealers in outlying suburbs. Before the advent of the motor truck a dealer who had his place of business eight miles from a large center could feel reasonably safe from metropolitan competition.

How is it today? Thirty-eight miles does not place the small store beyond the reach of the delivery service of large city establishments. Nothing, in fact, is more significant of the superior economy of the motor truck, than the manner in which it has enabled stores to do business at a distance and upset traditions of competition which have existed for years. (Figure 283.)

Truck Covers 1,150 Square Miles. A large men's furnishing establishment in Chicago covers a delivery area of 1,150 square miles and brings the sharp edge of city competition to a territory as far north as Lake Bluff, a distance of 38 miles,

west 28 miles to Hinsdale, and to South Chicago, 12 miles away.

This concern operates a fleet of ten ¾-ton light delivery cars, equipped with pneumatic tires, and capable of the same speed as a passenger car. This fleet, relatively small when you consider the tremendous area covered, enables the concern to give direct store-to-home delivery along fourteen routes, of which ten have two deliveries every day and three on Saturday. The trucks on suburban routes show an average of 68 miles and 59 stops daily.

The trucks leave the garage each morning at 7:15 o'clock and make a two-mile run to the store. The store building is constructed with a loading bay at which two trucks can be loaded simultaneously. When packages leave the wrapping desk they are put in a chute, leading to the shipping department. Sorters, at the end of the chute, place the packages in the proper crates and they are loaded into the trucks from these crates.

No distinction is made between city and suburban deliveries and the entire free-delivery territory is covered by the fourteen routes. The two longest routes have but one delivery on Monday. There are two deliveries on twelve routes on Tuesdays, Wednesdays, Thursdays and Fridays, and a third delivery is made on ten of the routes on Saturdays.

The northern route to Lake Bluff illustrates the delivery advantages which enable this concern to secure business not obtainable except with motor equipment—these advantages being speed, radius, frequency of call and advertising. Starting from the store at 8 a. m. the truck runs 38 miles to Lake Bluff and returns to the store in four hours. At 2 o'clock in the afternoon another trip is made over the same general route, a total of 80 stops being made throughout the day.

In addition to the driver, there is employed on each truck a bundle boy who does most of the delivering. Only when there are two deliveries to be made in the same immediate vicinity does the driver carry packages to the houses.

The record of one of these trucks shows a considerably higher daily performance, having covered 80,000 miles in 912 days and delivered 48,696 packages at a cost of 9¾ cents each. These totals of miles and packages are equivalent to 87 miles and 53 packages daily for three years.

Motor Trucks on the Farm. Let us now consider the case of two farmers who were engaged in market gardening

within five miles of Boston, and who were keen competitors. The conditions under which they worked were practically identical, and neither seemed to have the advantage of the other. Both used teams.

One of them, when his yearly lease expired, moved twenty miles out, bought a tract of ten acres and a light delivery car. The other renewed his lease on his present land and took over the land of his competitor. The results were interesting.

The farmer who moved out and motorized his delivery secured the following benefits:

1. The new land was about four times as productive as the land close in, and saved him a large sum in fertilizers;

2. The cost of the new land was about equal to the yearly rent of the land close in;

3. The new land was two times the size of the combined plots which the other now held;

4. The farmer who bought the truck not only grew better produce, and more produce at a less cost, but he acquired land hitherto thought valueless for his purposes; while the other acquired not even an equity, but merely paid rent on land which was worn out for agricultural purposes, but which brought a high rent because of the price of surrounding real estate;

5. Finally, the farmer close in could not meet this move merely by purchasing a truck, since a horse and wagon were sufficient for his needs, only one trip, and that a short one, being made daily.

The more we consider how motor trucks influence competition in modern business, the more we are impressed by the fact that other matters than the mere economy of truck transportation have a bearing on the final result. Thus in the case of the farmer, trucks made possible the use of richer and cheaper land; in the case of the oil company, service was the deciding factor; in the case of the newspaper, lightning speed secured the business; and in the instance of the asphalt contractor, motor trucks relieved him of the necessity of setting up additional plants on the outskirts of the city.

Time Always an Important Factor. In contracting work, time is often a factor of great importance. In fact, most large building contracts are figured on a time basis, and the speed and efficiency with which cement, sand, slag, gravel, and crushed stone can be hauled to the job and handled after it is there, has determined which contractor could secure the business.

As a result of close competition on big jobs, contractors have found it profitable and in fact necessary to install special devices

for facilitating the handling of material brought by their trucks. A striking example of this was furnished in the work of constructing a half-million dollar office building recently in Cleveland. Nine 5-ton trucks were used, each equipped with dump bodies operated by the engine.

The structural work of this building is largely concrete and many tons of sand, cement, and gravel were mixed daily. In order to do this work as speedily as possible, the contractors built a platform of heavy wooden beams on a level with the second story of the structure. Leading up to this platform were two inclines built of heavy planks, and with a grade of 10%. The trucks with their 5-ton loads were driven up the incline on one side of the platform. (Figure 284.) The loads were dumped through an aperture in the platform and the trucks driven across the platform and down the incline on the other side.

In this way the trucks were kept running continuously and no time was lost in backing and maneuvering around to find the most advantageous place for dumping. Contractors have highly praised this platform device and say that it saved a great deal of time and money.

We might multiply indefinitely instances where trucks have played an important part in securing business against competition. But even different examples point in the same general direction. Speed, strength, dependable service—these are the qualities which make truck delivery more economical and reliable than horse delivery. The keen merchant who avails himself of them not only protects his own business—he often increases it at the expense of a more sluggish competitor.

CHAPTER XXVII

USING MOTOR HIGHWAYS TO REACH DISTANT MARKETS

FROM St. Charles, Illinois, to Detroit, Michigan, is a distance by wagon road of 350 miles. A family which lived in the former city found it necessary to move to Detroit on short notice. The question arose as to what means of transportation should be used for moving the household goods. It was well known that the railroad could handle the job safely and economically. But an enterprising truck owner suggested that a motor truck be employed for this trip.

The suggestion was almost revolutionary, but the truck owner supported his proposition so strongly that the business man finally accepted it. The truck left St. Charles on a Tuesday morning and arrived in Detroit on the following Friday evening. The total elapsed time was three days, seven and a half hours, but the actual running time was thirty-eight hours. The furniture arrived at its destination without a scratch.

How Far Can a Truck Travel Profitably? Three hundred and fifty miles by motor truck, over good roads and bad, in competition with the smooth and level railroad. The incident —which is only one of several that might be cited—provides food for thought for the enterprising truck owner. How far can the motor truck go and return profitably? What is the extent of its radius?

Three hundred and fifty miles is an exceptional distance for motor trucks to cover, although there are several truck lines which travel a greater distance with regularity and profit. But how many truck owners have considered markets 50 or 100 miles away as being within their reach? There are scores, even hundreds of motor trucks which cover such distances daily. Not long ago five huge motor trucks with trailers attached, hauled 40 tons of steel from New York to Hartford, Connecticut, a

distance of 150 miles by wagon road. In Olympia, Washington, a transfer company moves household furniture a distance of from 50 to 125 miles. Recently this company transported household goods by motor truck from Olympia to Seattle, a distance of 90 miles, at a cost 25% less than that by rail.

Some Long Hauls for Motor Trucks. A Jersey City truck owner hauled a load of printing ink to Boston, 250 miles away and made the trip in thirty hours. A silk manufacturer is operating a fleet of trucks between his mill in Allentown, Pennsylvania, and his head office in New York City. Another operator hauled a load of merchandise from Southbridge, Massachusetts, to Newport, Rhode Island. The distance was 168 miles; the roads were deep with snow, yet the trip was made profitably and without mishap. The truck left at 4:30 in the morning and was back again at nightfall the next day. On another trip this truck went through the territory of five states, a round trip distance of nearly 300 miles. But the examples of long hauling already successfully accomplished are so many that it would be repetition to relate them. There are scarcely any two cities of any size, within a hundred miles of each other, which are not connected by one or more motor truck lines. New York and Philadelphia, New York and Hartford, Connecticut, Detroit and Pontiac, Olympia and Seattle, Cleveland and Akron, Toledo and Cleveland, Toledo and Detroit, Chicago and Toledo—these are only a few.

What does this mean to the business man who has something to sell and must have markets in which to sell it? It means that the big markets have been brought nearer than ever, and that customers which formerly had to be reached perhaps through jobbers or dealers may now be reached by the producer or merchant himself. The business horizon has been pushed back, so to speak, and countless busy motor trucks are swarming out over the distant fields, carrying more goods greater distances and bringing back larger profits.

Connecting City and Farm. Northeast of Baltimore lies a country rich in farm and dairy products. Two great railroads run their lines through this territory, providing freight and express service for the little towns along their routes. Over the same territory a motor truck line is operated. Daily routes extend from Baltimore to cities and farms within a radius of 30 miles. The trucks stop not only at the towns they run

through, but at farms between towns, and pick up farm and dairy products for the Baltimore market. At the same time they take orders for goods to be purchased in Baltimore and delivered on the next trip. In that manner the trucks secure a load both ways. They maintain a fixed schedule so that the farmers are ready for them when they arrive.

Outside of Boston, New York, and Philadelphia, the region of market gardening has been pushed back as far as 25 or 30 miles. It is a not uncommon thing to see motor trucks come to market with vegetables raised 40 miles away from the metropolis. A Camden, New Jersey, fruit grower, runs a 5-ton truck daily to New York city, 85 miles away.

The Reasons Why. How is it possible for motor trucks to haul goods such distances as 50 or 100 miles in competition with such an economical carrier as the railroad? When your goods are in the box car which is rolling along over a smooth, almost level track, they are being hauled in the most economical manner known to land-borne commerce. Nine pounds of drawbar pull will move a ton of your freight over level tracks. Five men can operate a long freight train. How can the motor truck, carrying a relatively small load and operating over all kind of road surfaces compete with such a carrier?

The reason lies "at both ends of the route." Goods must be packed and crated, and carried to the railroad station. Then they must be unloaded, loaded on to a hand truck, then unloaded and put in the station, then loaded on the freight car—all this before the consignment begins its comparatively smooth journey to its destination. At the other end, the terminal, the consignment must go through a like process of handling, and finally must be delivered to the consignee. The fourth Assistant Postmaster-General in a public address proved that a shipment of eggs originating in a small town outside of Philadelphia and consigned to a customer in Philadelphia, must be handled 14 times before it reaches the customer. Looking at this from a dollars and cents point of view, it is obvious that these extra handlings and extra days in storage cost money and must be paid for by the shipper or the customer. If this expense is relatively small in comparison with the sum saved in the actual hauling the railroad method will prove economical in the end.

When Motor Trucks Are Not Profitable. Suppose, for instance, that a 5-ton load of machinery is to be shipped from

Detroit to Boston. Putting aside the matter of time or urgency, it is clear that shipment by rail will prove more economical than shipment by motor truck even though the truck would save considerable expense at the beginning and the end of the trip. The cost of extra handlings by the railroad would be absorbed in the thousand or so miles of smooth, inexpensive travel. Suppose on the other hand that the same shipment were to be sent from Lynn, 12 miles away, to Boston. The same cratings and packings, the same handlings and the same terminal difficulties—but only 12 miles of travel. There is not time, so to speak, for the economy of the rail to make up for the wasteful handlings at the point of origin and destination.

An Actual Experience. This point cannot be better illustrated than by recording, in his own words, the experience of a Brockton traffic manager who used motor trucks to transport goods between two branch factories and headquarters even though rail service was available.

"Hold the Weymouth truck until you can load that lot of findings that Department 6 has for us." This is typical of early morning long distance telephone calls from one of our branch factories. And those findings will be in the Weymouth plant before noontime. It is merely cited as an example of the service possible with a motor truck system which we operate. On the other hand, can you fancy asking a railroad to hold its freight trains for a few minutes to enable you to get on one more much-needed shipment?

Motor trucks have effected a saving in cost as well as a betterment of service. But this is getting ahead of the story. To begin at the beginning, we have our main factories in Brockton. There is a branch plant in Weymouth, about 17 miles distant by road and another in Boston roughly 25 miles away. The relative locations of Brockton, Weymouth, and Boston are shown on the map in Figure 288.

If we rely on the railroads between Brockton and Weymouth, a shipment goes to Boston, where it has to be teamed from the inbound freight house to outbound freight house (because it is in less than carload lots). Then it is freighted to Weymouth, where it is teamed to the factory. Freight handled in this way between Brockton and Weymouth costs 30 cents a hundred.

It is desirable to ship too often to warrant waiting for a full car. While the distance in a direct line is only a little over 15 miles, it takes until the second morning for a shipment to get to Weymouth by this freight method. In addition, there is the disadvantage that if a car weighs under 6,000 pounds there is a $2 switching charge at the sidetrack in the Brockton plant.

With the 1-ton motor truck which we have in this service a load of box toes, counters, heels, and other shoe findings and box shooks is taken on and the start made from Brockton at 8 o'clock Tuesday, Thursday, and Saturday mornings. This arrives at about 9:30.

FIGURE 285: Between New York and Philadelphia, motor trucks are actually competing with the railroads as handlers of freight, and with success in many instances. They deliver direct to the customer's door instead of at a terminal.

FIGURE 286: There are over 2,000,000 miles of road in this country but the percentage that is passable for trucks all year round is surprisingly small. A stretch of road like this may render useless miles of the best macadam beyond it.

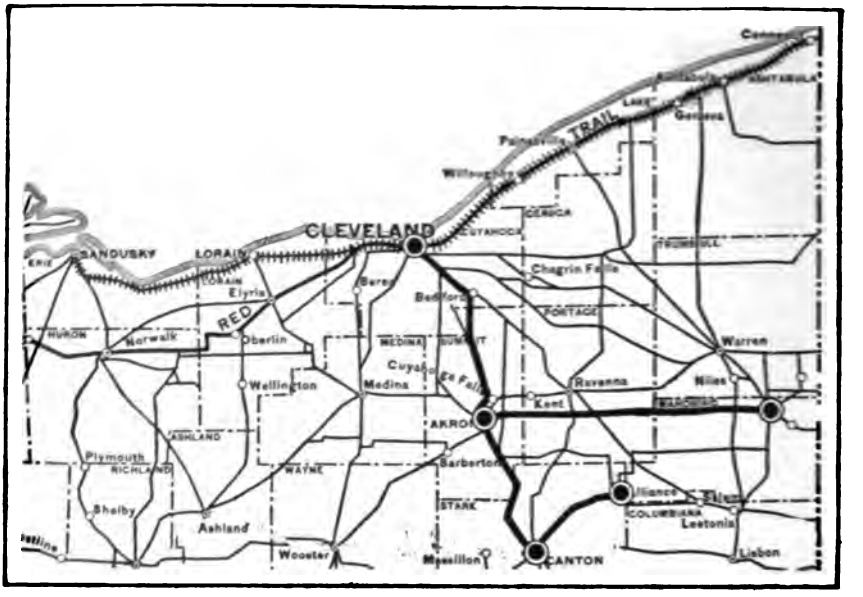


FIGURE 287: Motor trucks are competing with railroads not only by hauling goods over long distances, but also by routing goods from a city on one motor truck line to their destination on another.

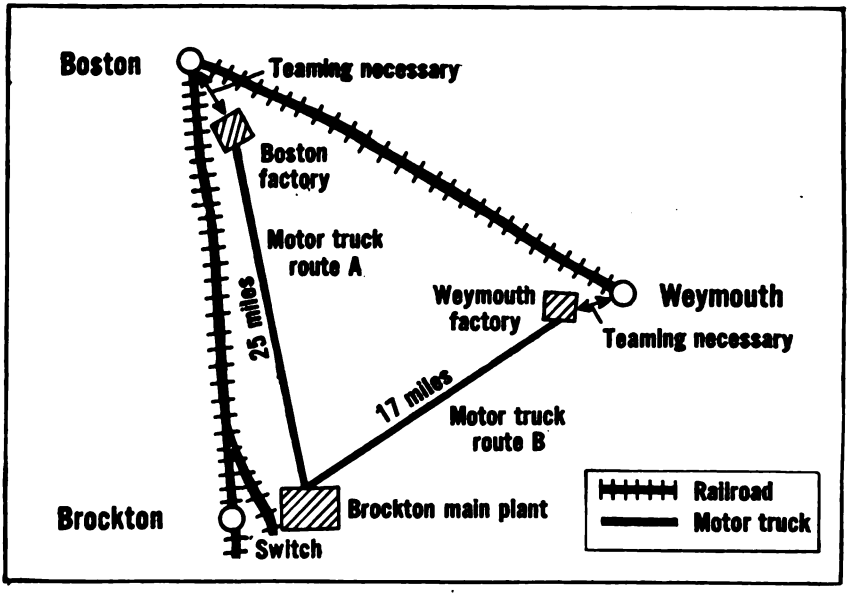


FIGURE 288: This map shows the route used by the trucks of a Brockton manufacturer. He relates in this chapter how he saved thousands of dollars a year by establishing this motor route instead of relying on the railroads.

The truck is unloaded immediately and reloaded, this time, with finished shoes, which are taken to Brockton to combine there with other shipments into carload lots. There is not enough tonnage manufactured in the Weymouth plant for any one transfer point to make full car shipments direct, and freight facilities are poor, there being no switch track. On the return trip, the truck leaves soon after noon and arrives in Brockton at about 2 o'clock. After the truck is unloaded, the driver has the remainder of the day to take proper care of the truck, or he may be requisitioned to do odd trucking jobs about Brockton.

Costs with the motor truck on this trip run about 10 cents a hundred, or one-third of the freight costs between Brockton and Weymouth. But even this large saving is outshadowed by the large value of service given. On only two days during 1917 was the service interrupted, and that was one day at a time after two separate severe snow storms.

On the alternate day the same truck goes between Brockton and the Boston plant. It leaves Brockton at 8 o'clock with the same character of load as in the Weymouth case, and makes the run in about 2½ hours. It leaves Boston on the return trip at about 1 o'clock, and gets to Brockton at 3:30 or 4 o'clock.

We save only a few cents a hundred on this haul over freight, but this Boston schedule keeps the Weymouth truck busy, and gives the Boston factory far better service than the railroad could. Furthermore, this motor truck service enables the factories to work much closer on available supplies than would be possible with freight methods.

Such Service a Benefit to the Public Welfare. The condition just described prevails in hundreds of localities. It is not exceptional, but is indeed so general that the railroads, civic bodies, and even governments have recognized it and made suggestions which, if followed out, will mean not only a saving to the truck owner, but a service to the public welfare. England, in her emergency, fixed the hard and fast rule that railroads must not carry freight within a zone of 25 miles from the center of such cities as London, Liverpool, Manchester, and others. That meant that goods shipped inside the 25-mile zone to other points inside that zone had to be transported by motor truck.

As a matter of fact, similar embargoes were placed on certain eastern cities in this country, such as New York and Philadelphia. The three largest express companies sent out to their patrons a circular signed by their respective vice-presidents, requesting that—

"Motor trucks be used for the shorter haul traffic in and around the congested districts, and that only such shipments for near-by points as actually demand express service be offered to the express companies, so that the traffic requiring expedited service to and from the distant points may be cared for."

Here is formal and official recognition of a condition which affects the profits of many a business man who operates trucks.

The truck owner need not take it on faith—it has already attracted the attention of experts, and their judgment has been expressed in unmistakable terms.

Some Actual Accomplishments. Time—money—service. At least one of these factors enter into every problem of making long hauls by motor trucks. But let us look at the matter in terms of expansion of business, and larger and better markets. Two motor trucks have eliminated a branch establishment, a branch manager, a bookkeeper, a plant foreman, two horse-drawn wagons, and two drivers for a provision company in Cleveland—all at a cost barely equal to previous charges for freight and drayage alone. The motor trucks are also increasing sales through giving prompter service, as well as cutting costs, on business that was formerly handled over the railroads.

To the west of Cleveland, 26 and 30 miles respectively from the company plant, lie the two thriving centers of Elyria and Lorain. Along the roads leading to each town are smaller suburban localities not to be overlooked as desirable markets. Originally the provision company had a branch house with cold storage equipment at Lorain, manned by the force of five employees enumerated. (Figure 289.)

To supply the needs of this station, a freight car was routed each day to Lorain by way of Elyria, the shipments being made up partly of goods to fill orders, and partly for stock. The car arrived at Elyria, under normal schedule, on the day after packing. There it was uncoupled and Elyria shipments were removed. On the second day after packing, if all went well, it reached Lorain. There the remaining goods were unloaded, transferred to a wagon, and hauled to the branch house for storage or distribution. Orders could not be delivered until at least the third day after the car was packed.

Why This Delay Was Costly. This delay was costly in two ways. Because the provision business is highly sensitive to weather and other conditions, it is difficult to forecast demand. For this reason the branch was not infrequently overstocked on individual lines, with the consequent danger of loss through deterioration. Reduced prices as an inducement to move excess stock were not unusual. Also, there was a continual danger of complaints from the customer because the goods were three days "on the road" to him. From both angles conditions were highly unsatisfactory to the company when they decided to

employ motor trucks to develop and handle this desirable suburban and small-town trade.

The present plan presents some graphic and profitable contrasts. Of the former force at Lorain, only the two salesmen remain. One is stationed there, the other has his headquarters at Elyria. Each covers his town and way-station toward Cleveland during the day, and mails in his order special delivery in time to reach the Cleveland plant in the early evening.

How the Trucks Are Packed. Each order is numbered serially by the salesman in the order that it should be delivered. The truck packer then packs the truck in reverse order, so that the driver need waste no time in locating the next delivery. In

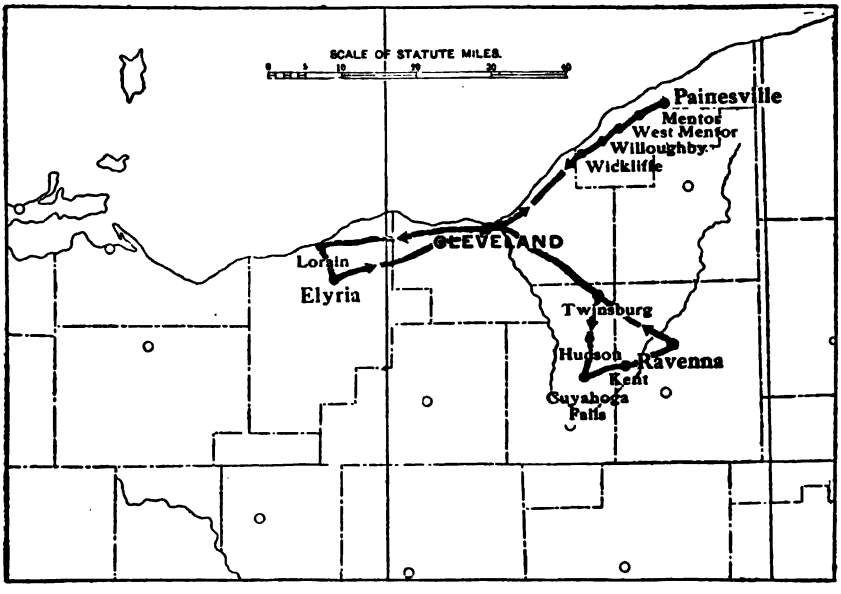


FIGURE 289: In terms of expansion of business a Cleveland provision dealer found motor trucks traveling over these routes very profitable. In fact, two trucks eliminated a branch office, five employees and two horse-drawn wagons.

other words, the salesman routes the truck among his customers each trip in the order which he, from his familiarity with the locality, knows will save time and mileage. The packer observes his instructions, and the driver has merely to follow these exact directions in covering his route.

The orders received in the early evening are packed in the early morning hours, and the truck leaves the home plant at

6 in the morning. A 3-ton truck operates daily over the route to Lorain, delivering at intermediate points also. The Elyria route is covered every other day by a 3-ton or a 1½-ton machine, depending on the bulk of the orders on hand (goods are no longer shipped for "stock"). If the 1½-ton truck makes the trip, the 3-ton truck is employed on city hauling. The monthly average mileage of the Lorain truck is in the neighborhood of 1,700 miles.

Some Additional Savings. While the solution of the company's Elyria-Lorain problem, because of the abandonment of the branch station, represents the greatest saving through using motor trucks, the company operates two other notable routes which are interesting—in one case because of the number of communities served, and in the other because of the greater length of haul.

On alternate days a truck operates from Cleveland directly east through Wickliffe, Willoughby, West Mentor, and Mentor, to Painesville, 29 miles out. On three days a week, also, a similar service covers a 90-mile route reaching Twinsburg, Hudson, Cuyahoga Falls, Kent, and Ravenna—the last named is 39 miles south of Cleveland. The Painesville route illustrates the difficulty of freight shipments. In that territory the company had the alternative of paying a flat charge of $5 for each way-station stopover, or of paying freight on the full carload to the farthest point. In either instance, freight service was slow.

Four Distinct Advantages. To summarize briefly the many advantages which this company feels that it derives from motor truck delivery to towns near by:

(1) The trucks operate at a cost no greater than the sum of the freight costs and drayage charges of the earlier system. The previous overhead expense of the branch station, made up of five salaries, rent, upkeep, supplies, and depreciation, is now a total saving of no inconsiderable size.

(2) All goods now reach the customer absolutely fresh, always on the same day that they leave the plant. Over half of the orders are delivered the day after they are placed. These two facts are naturally proving powerful sales arguments, immediately apparent in results.

(3) The company is practically free from costly delays, their resultant complaints from customers, and claims against the railroads for depreciation—expensive in the time they

formerly consumed for the office departments. With truck delivery, the whole transaction is personal, from the time that the salesman enters the order to the minute that the truck driver, the company's representative, unloads the goods at the customer's place of business. All the many chances for misunderstandings, mistakes, and delays which developed under the old system—where both a railroad company and a drayman handled the goods in shipment—are now eliminated.

(4) Perhaps the most graphic result of the new policy, however, is the fact that the company's sales charts show that the cost of selling and delivery in the Lorain-Elyria territory has been cut one-half. All the other advantages may, therefore, be fairly regarded as "velvet."

Another Striking Example. A second striking instance of how motor trucks are increasing the sales possibilities of one concern is told in the words of A. F. Roellig, general manager of the J. B. Van Sciver Company, of Camden, New Jersey. This company manufactures, imports, and jobs furniture, and interior decorations direct to the consumer. Mr. Roellig says:

> We are serving a territory today fully five times as large as we served a dozen years ago, and we are making retail deliveries direct from our store to the homes of consumers in all of this territory. Even as long ago as 1895, we used a big fleet of horse-drawn trucks to make deliveries in our own town and the smaller towns near by. Now we have only a few teams for hauling freight between our store and the depot, and maintain a fleet of automobile trucks composed of one 3-ton truck, three 2-ton trucks, and eight trucks of a capacity of 1½ tons. With this outfit, we are practically independent of freight deliveries, and have reduced our packing department to almost nothing. During this time of unusual shortage of lumber for crating, and slow freights, we can actually give much better service than we could if we had to depend on freight shipments.
>
> While we advertise a great deal, our business from a distance has been a matter of growth. A customer who lives here may move to a town a little farther away, and—having been pleased with the service and the goods secured from us while living here—naturally orders from us again. We can give him practically the same service that he received when he lived in our own town, unless he has moved too far away. I think the longest trip our trucks have ever made was to the city of Washington, 137 miles away.
>
> We had to charge a little for this delivery, because it was such a long trip. Ordinarily, however, deliveries within a radius of 70 or 80 miles are made free. This customer preferred to have his goods delivered by automobile truck, and was willing to pay the little extra cost for the service.

What Freight Shipment Would Mean. This case illustrates quite well the advantage to the purchaser of having the

goods delivered by truck. If this furniture had been shipped by freight it would have had to be handled six times as follows: The furniture would have been crated; it would then have been loaded into a van and hauled to the railway station; there it would have been unloaded and loaded again later into a car; when it arrived at Washington it would have been unloaded from the car, then loaded onto a van, and then unloaded at the home of the customer, where it would be uncrated.

As it was handled, the furniture was moved only twice. It was moved out of our warehouse into the van, and then out of the van into the customer's home. There was no need for crating, and no serious chance for damage to the pieces.

The Problem of Roads. Long distance hauling, already a proved success in hundreds of instances, brings the truck owner face to face with the problem of good roads. The lack of good highways connecting important points seems to be the only limitation on the indefinite expansion of long distance trucking. It is well, therefore, that the truck owner should gain an idea of the essential facts of the road situation, in order that he may be able to lend his influence in the direction of wise planning of our highways. We have in this country over 2,300,000 miles of roads. Of this mileage only 10% deserve the name of roads. And only a little more than 1% of these roads are so constructed that they will stand motor traffic all the year round.

Not only that, but a system of connected and coordinated highways does not exist. The fleet of army trucks which made the run from Detroit to the Atlantic seaboard encountered many serious difficulties. Although the route lay through a highly developed region, and passed through several important cities, it was necessary to spend months in planning the route, in investigating reports of road conditions, in building gaps in the proposed road, and in repairing and strengthening such parts of the road as were impassable for trucks.

This condition which exists between some of our largest northern cities is repeated everywhere throughout the country. Our highway system has been compared to a crazy quilt, consisting as it does of roads which begin and leave off without order or arrangement, or which are constructed for a few miles of one material and for a few more miles of something else. Often gaps will exist in an important intercity highway which prevent motor traffic as completely as if no highway existed.

What Motor Truck Roads Cost. This cannot be remedied in a day. Road building is a long and expensive art. The distances in this country are so large and spacious that it would be impossible to connect all the cities and towns with roads in a score of years. And what adds to the difficulty is that roads suitable for motor truck traffic are expensive, costing between $15,000 and $20,000 a mile. The motor truck has made new demands of the road builder, and a motor truck highway, to be worthy of the name, must be hard-surfaced, must have a concrete base from six to ten inches thick, and must have a minimum width of twenty feet.

In view of these facts, it seems expedient to use careful selection in planning our motor truck highways of the future. The war emergency has made our needs stand out in bold relief. In a public address, W. O. Rutherford said:

"What is the urgent need at the present time? Motor trucks we have in abundance, the need is for roads for these trucks to run on main arteries of traffic between important points. The need of good roads everywhere is too apparent, too well recognized, to require any proof. But we must give up for the moment those large plans which cannot be worked out for ten or a dozen years. We must build those roads which we have most urgent need of today These are, without a doubt, the main highways connecting important cities, railroad centers, and waterways, roads which will carry, not hundreds, but thousands of trucks."

The fact is, and business men should recognize it, the truck has established itself as a road locomotive. The authority just quoted has the following to say on this statement.

"It is not impossible that motor trucks, swarming over our highways may, in the not distant future, carry as much freight as railroads with their restricted mileage, their limited equipment and their cramped terminal facilities."

This is the vision of the near future, which is already in process of being realized, and, like the railroad, it will affect profoundly everyone who has goods to sell and must find a market in which to sell them.

CHAPTER XXVIII

MAKING YOUR TRUCK ADVERTISE YOUR BUSINESS

A SHOE dealer in Philadelphia, whose store is some distance from the shopping district, bought a truck and ordered a body built in the shape of an enormous shoe. The vehicle made a tremendous hit. Wherever it went on the busy city streets it was the subject of comment. People soon came to know this shoe dealer better than many a one longer established. Six city inquiries came in the first morning the new truck was exhibited. More important still, several of the shoe journals over the country heard of the plan and sent for photographs. These were published, and as a result mail orders for shoes began to come in from cities and towns often at a considerable distance. The shoe dealer doubled the size of his store. The advertising cost him nothing, as he had to have a delivery truck anyhow. (Figure 290.)

Unquestionably the motor truck, taken merely by itself, possesses considerable advertising value. Its speed and capacity impress the eye. Its great strength, its power of performance in comparison with the limited work of the horse, excite admiration. Its costis a subject of gossip. Even its machinery is a topic of interest. It stands as a symbol of progressiveness.

The Motor Truck, a Sign of Progress. He who installs a motor truck is at once credited with being modern, enterprising and up to date. If he claims to give better service he is generally believed—simply because he has a truck, though he will, of course, have to have more than that to back his claims!

His standing is improved, much as if he had bought some valuable property. Not merely achievement, but promise of achievement, bring him business. If he is a grocer, people will prefer to trade with him; if he delivers lumber, they will call on him for prompt service; if he is a transfer man, they will

have their household goods moved in his trucks (Figure 291), even if they could get substantially the same service and price from the horse-drawn equipment of his competitor.

The advertising value of the motor truck is indeed rated by many concerns as a close second to its speed as a factor in increasing business.

It is a source of profit which can be had almost for the asking. It costs no more to maintain and drive a truck equipped with a body designed to attract the eye and put over a "selling punch" than to operate a plain and ordinary-looking motor, bearing merely the name and address of the concern. Still, only the few are doing it, the many are content with the old ways.

Think of the tremendous "circulation" obtained by a cleverly designed truck which flits in and out through the crowded streets of a large city. Thousands of persons look at it every hour, perhaps a hundred thousand in the course of a day. And it is a picture full of life and action, for it not only presents the trademark and the essential features of the product in question, but it is a living testimonial to the energy, aggressiveness, and power of the concern whose name it bears, and unmistakable evidence of the purpose and ability to render service

At the same time the plain, ordinary truck which passes before the eyes of the same thousands and hundreds of thousands is often unnoticed. It is a carrier only, not a salesman. It hauls the goods, but it does not cry his wares. Why not?

Publicity a By-Product. A two-ton truck was recently delivered to a well-known manufacturer of rubber heels, bearing on each side a reproduction of a poster which the company has used for several years to advertise its product. (Figure 292.) These posters may be seen in practically every subway and elevated railway station in our large cities. Not only are a great many of them needed, but each one must pay its rent, its advertising "space," in return for the privilege of meeting the eyes of the thousands of passengers who pass by.

On the sides of the truck the same poster, painted in gold and maroon, strikes the eyes of all who see the truck. Instead of the thousands which the subway poster attracts at so much per month, the truck poster carries its message to tens of thousands at nothing per month. It is a moving billboard, which tells its story while the truck is actually delivering the goods and delivering them at a marked saving. It is a by-product,

so to speak, a "something-for-nothing" which the merchant can have if he merely shows the initiative. The president of the rubber company said: "We are getting more in direct service than we paid for, and advertising in addition, so you can appreciate that we are pretty well satisfied with our bargain."

The many ingenious ways in which uniqueness of body design is secured should be of interest to the truck owner who means to take advantage of this form of free publicity. The following are several examples of ways in which merchants have actually worked out this interesting problem:

Some Typical Examples. A cigar retailer in a middle western city has mounted a huge cigar on his delivery car. The cigar bears a large gold band on which the name of the brand can be plainly read. Not only that, he has connected the exhaust of his engine with the cigar, so that it smokes while the engine is running. Needless to say, this attracts almost universal attention on the street, and this cigar dealer is better known than many another in the same city who may spend hundreds of dollars on more formal kinds of advertising. (Figure 293.)

In Boston it is noticeable that a great many trucks have signboards running across the roof at right angles to the direction of travel. These signs are in addition to those that appear on the truck sides. The use of the additional sign is apparent when one looks down the street, since the name of the truck owner can be discerned two blocks away.

A transfer company in a western city has given an original treatment to its large vans. These are painted light yellow, and against this vivid background, appears the slogan in red:

OH, LOOK!
THE SQUARE DEAL TRANS-
FER COMPANY IS DOING IT!

Down in one corner is given the address and telephone number of the company. The manager says that many customers when calling on them for service mention the fact that the sign on the trucks first attracted their attention.

A Truck that Tells the Correct Time. In Milwaukee there is a small delivery truck which attracts no end of attention. It belongs to a jeweler, and, quite appropriately, it carries a clock on the side of the body. The clock serves to indicate the nature of the business. Moreover, it tells the right time.

FIGURE 290: This man sells shoes, and thousands of persons know it. The body caused a mild sensation wherever the truck went, and not only gained local business, but secured out-of-town orders as well, for the picture was widely published.

FIGURE 291: Why is it that many prefer to have their household goods moved by truck rather than by horse and wagon, even when the cost is the same? The transfer man, who recognizes the reason, usually makes money out of it.

FIGURE 292: People walk before a window display or past a billboard, but a dignified advertisement on a truck carries a message to crowds, as would a billboard on wheels or a window display sauntering about town.

FIGURE 293: This truck attracts attention wherever it goes and brings a lot of additional business, its owner declares. The cigar "smokes," for the exhaust is connected with it, which is the most novel feature of its advertising value.

FIGURE 294: This concern hired an artist at considerable expense to paint its trademark on the side of its trucks. The money was well spent, for the picture is seen and admired by hundreds every day the trucks are in operation.

FIGURE 295: Flowers—where the crowds can see them, made this florist's name almost a synonym for the word "flowers." The body cost a pretty penny but the pennies it has brought in are "pretty," also, says this business man.

FIGURE 296: It takes but a glance for the crowds on the sidewalk to see that this is a jeweler's truck, and what's more, they generally remember the name. This kind of advertising is often effective when more commonplace methods fail.

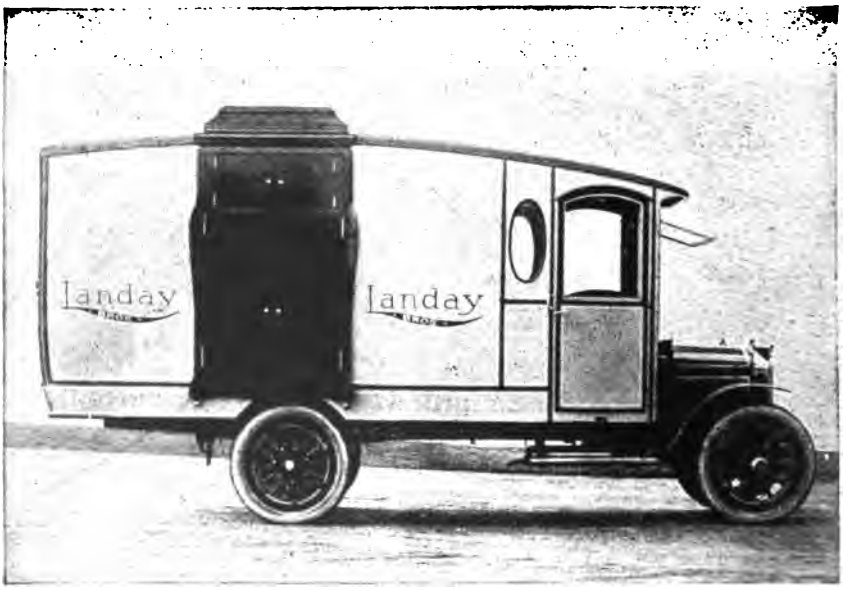


FIGURE 297: If you sold phonographs and had to have a delivery car, wouldn't it be worth your while to have a body made in this unique shape? This dealer thought so. He figures that the cost has been repaid many times.

(Figure 296.) Being large, it can be read easily from the sidewalk. The master touch is supplied by a slogan, or it might be called a pun: "Our Time Is Yours," which is printed directly around the clock. The effect is very pleasant, and attracts a great deal of business to the jeweler.

A dealer in talking machines has constructed a body in the shape of one of his instruments, with good effect. The door of the cabinet serves as the door of the truck body. (Figure 297.)

A druggist has erected a huge mortar and pestle on his delivery truck. This symbol is not only distinctive of the business, but provides a rather spacious receptacle as well. Another unique body for a druggist's delivery car is one imitating a bottle of some well-known medicine. Sometimes a specialty is chosen which lends itself readily to such treatment, providing capacity as well as giving a unique appearance.

Most truck manufacturers encourage truck purchasers to request special bodies as they realize that such equipment will not only serve to draw attention to their truck, but will also increase the customer's business. An eastern manufacturer issues a standing invitation to prospects to send copies of their trademark, and let him design a body suited for their use, that will give them real display value.

Advertising Opportunities Almost Limitless. There is no end to the number of distinctive or unique bodies which can be devised to fit various lines of business. Generally the nature of the business itself suggests and even prescribes the treatment. Thus a baker will use a body that resembles a loaf of bread or perhaps a huge cake, the body on a dairy truck may be in the shape of an enormous milk bottle lying on its side, and a meat packer may choose a huge ham, or a cow.

It should be noted, however, that the more freakish or unusual bodies are generally used on trucks of small size, or light delivery cars. The shoe dealer, who has to deliver a few dozen pair of shoes, can carry them in a body shaped like a shoe, for he is not particularly concerned with the problem of space or capacity. It is entirely different with the coal dealer or the lumberman. They generally carry capacity loads, and as every foot of space counts they could not put up with a truck body which gave them less than the maximum amount of room, or one which by reason of indentations, curves, and so on, hindered the free handling of material. The truck purchaser should bear this in mind,

and before he consents to using an odd-shaped body he should consider carefully whether he may not lose more than he gains by so doing.

As a general rule, owners of large trucks are unable to make effective use of specially designed bodies to express an advertising idea. They can, however, accomplish the same results by decorative panels, signs, or special features of this kind. They should avail themselves of every opportunity that presents itself.

Making Trucks Advertise a Dairy. A Philadelphia dairy installed some five-ton trucks recently, and equipped them with huge van bodies. They employed a clever artist who painted a meadow scene across the broad white sides of the truck. The effect was most inviting. One could not look at the picture without getting a sense of the purity and coolness of milk, and the general wholesomeness of all dairy products. It is unnecessary to point out the very real benefit which the dairy secured from this body.

There is scarcely a line of business which does not suggest some idea capable of decorative treatment on the outside of the truck body. But if the business man does not care to give expression in a pictorial way to some selling point, he should by all means present his trademark or the brand name of some one of his products on the panel of his delivery car. The advertising is to be had merely for the asking.

How a metropolitan newspaper made advertising capital out of its purchase of twenty-eight trucks was left untold in the first chapter. This paper not only secured advertising from the actual trucks, but it also advertised the trucks. Full page spreads were run calling attention to the purchase and pointing out those very things which we mentioned near the beginning of this chapter—the progressiveness, the superior service, the growth of business which such an installation meant.

A Florist's Unique Truck. A Chicago florist, who caters to a very high-class trade, conceived and designed a type of body which is unique. In its lines this truck resembles a huge sedan decorated with exterior frescoes of rose wreaths. In fact it has some of the features of the sedan, such as inside drive, large windows, and low waist line. But when the truck has been partly filled with floral pieces, all showing plainly through the large plate glass windows, it is suggestive of a colonial coupe, banked with flowers for a bridal couple. It is fitted with an

electric lighting system by which the interior may be flooded with light, showing it off to good advantage even on the darkest street. (Figure 295.)

There is, however, nothing sentimental in its purpose, even though its appearance seems to belie its commercialism. Its first appearance on Chicago streets drew such a large crowd that police reserves were required to keep traffic open. Painted a vivid green, nature's own hue as a background for the moving floral display, the truck has given its owner a huge amount of advertising which has had a decided effect in increasing his business.

While the florist's truck is unique and suitable for his business alone, the idea can be modified to take care of other lines of business. The "show case body" can be used by almost any dealer in small wares which can be arranged in an effective display. The idea was originated by a Los Angeles dealer in health foods, who used it for display only, showing a table set with a meal of health foods. This kind of body is very practical, inasmuch as it is not necessary to build it in an odd or eccentric shape. It has the advantage of displaying the actual wares instead of presenting a representation of them.

Copyrighting Special Bodies. Special bodies, artistically planned and executed, come under the copyright provision which protects designs. A merchant who has devised a special body, which has been the means of securing much advertising and business, should protect it by taking out the necessary papers. Body makers themselves should look into this matter, and copyright their special designs. Having secured a copyright the body maker can give permission to reproduce the body as he sees fit, generally establishing a limit of not more than one body in the same town.

CHAPTER XXIX

INCREASING PROFITS BY CUTTING DELIVERY COSTS

HOW merchants have been able to cut the cost of delivering goods, whether it be coal or groceries, gravel carried by the yard, lumber by the thousand feet, or dry goods packages weighed by the ounce, is one of the most interesting phases of the story of the motor truck. If, by cutting the delivery cost, a truck operator increases his profits, widens the scope of business, or becomes able to do more business on the same capital, he is enabled to quote lower prices than a competitor, or to maintain the same prices and increase his hold on his customers by giving more prompt and frequent service.

At the bottom of it all is the consideration of cost, and even beneath that, perhaps, is the principle that delivery costs can be reduced only by keeping the motor truck busy. In Chapter II we saw that the effectiveness of the motor truck is expressed by the formula: "Speed × Load = Work."

Given a motor truck which develops four times the speed of a horse and wagon and carries four times the load, the resulting effectiveness is sixteen times that of a single horse. This figure correctly represents the possible effectiveness of the average five-ton truck. Where such a truck is used day and night this figure is multiplied by two, and cases have been reported where one truck has done the work of thirty-five and even forty horses.

Maximum Efficiency Seldom Attained. It is seldom, however, that conditions are found where a truck can make use of its maximum speed and carry its maximum load without interruption. Most trucks operate at less than half their possible effectiveness. The problem of the business man, therefore, is: "How can I keep the factors of speed and load as near to capacity as possible?" He may fall far short of the possible effectiveness, and still declare a profit from the operation of his trucks.

An enterprising contracting concern in Chicago recently made a striking demonstration of the effective use of motor trucks, properly handled, under supposedly unfavorable conditions.

A contract for hauling sand and gravel, to be used in paving, was held by a teaming company. This company had never used motor trucks, but the manager was nevertheless eager to find out whether or not they would prove economical for work of that nature. The test took the form of a subcontract to the contracting concern already mentioned. The subcontract was signed at 40 cents a yard, the prevailing rate paid to team owners for hauls of a mile or under. This figure needs an explanation.

Loose material, such as sand and gravel, is generally brought into the city by rail. The cars in which it is carried vary in type. Some have hopper bottoms, some have tight bottoms, and some have drop doors extending the length of the car.

With a pair of horses hauling two-yard dump wagons, loaded by the driver and two shovelers, the cost, figuring a speed of three miles an hour, is as follows:

Working hours, 10	Number of trips, 15
Round trip, 1 mile	Number of miles, 15
Loading time, 15 minutes	Number of yards, 30
Traveling time, 20 minutes	Rate, per yard, $0.40
Unloading time, 5 minutes	Daily gross income, $12

The income of $12 a day for a two-horse team, one driver and two shovelers is by no means excessive. For teams 40 cents a yard is a fair price.

In view of the possibility of cutting costs, the contracting company attacked this problem with considerable zest. The proprietor of the concern was a student of transportation problems. He saw at once that the delay in loading must be reduced.

The problem of unloading loose material from freight cars had resisted the adoption of special devices on account of the fact already mentioned—namely, that these cars vary greatly in design. Moreover, none but a portable device would do, because of the trouble and expense of moving heavy apparatus from one car to another. Objections from the railroad companies might also be expected

Meeting Special Conditions. The contracting concern devised a portable unloader, in the form of a tip-bucket mounted on struts so constructed that the whole frame could be raised or lowered according to the height of the material being unloaded.

(Figure 298.) These buckets were of two-yard capacity, and the frames were mounted on wheels. One of these devices was stationed at each end of the car, the buckets being tipped slightly toward the car while it was being loaded. Two good shovelers could fill one of these buckets in about sixteen minutes. Four or five shovelers were used in each car, and as the capacity of each of these buckets was two yards, or only half the capacity of the average 5-ton dump truck, both buckets were filled before the truck returned for its load. The truck would then drive up alongside—the first bucket would be tipped and its load discharged into the truck body. The truck would then move ahead a few yards beside the second bucket, where the operation would be repeated. The whole process of loading the truck, exclusive of shoveling the material into the buckets, which, of course, was done while the truck was busy on the road, consumed 30 seconds. The time gained, therefore, was 30 minutes minus 30 seconds, or 29½ minutes.

What the Trucks Accomplished. By the use of two 5-ton trucks with dump bodies operated by the engine, and with the loading device described above, the table of average operating time and income began to look far different from that which recorded the returns of teams hauling and loading by shovel.

Working hours, 10	Number of trips, 52.1
Round trip, 1 mile	Number of miles, 52.1
Loading time, ½ minute	Number of yards, 208.4
Traveling time, 6 minutes	Rate per yard, 40 cents
Unloading time, 5 minutes	Daily gross income, $83.36.

This remarkable work was not accomplished, however, except by diligent planning. Or, put it rather the other way, diligent planning was used to gain this exceptional result. The fact is, with such enormous quantities of material handled daily, minutes were golden.

Earning a gross income of $83.36 a day of ten hours, the income per minute was 13.89 cents. For five minutes, it was 69 cents; for ten minutes, $1.38.

In order to show the cost of lost minutes and the consequent loss of profit, this concern kept a careful record of the various delays and their causes. The following table shows the delays met with in one hour of an average day's run and also the dollars and cents value of this lost time. For a ten-hour day the loss would total nearly $23.

Held up by traffic (2 minutes)	$0.278
Held up by trolley car (2 minutes)	.278
Driver dismounted to loosen tailgate (1½ minutes)	.208
Loaded by shovel at another yard on special trip; yard not equipped with loading device (9 minutes)	1.250
Blockaded at dumping point (2 minutes)	.278
Total lost time, 16½ minutes	$2.292

The income of the average two-horse wagon hauling loose material from the car-side, a round-trip distance of one mile at 40 cents a yard, was $12.00 or $1.20 an hour. The motor truck, effectively used, became so productive and made time so valuable that the average time it lost during every hour from slight and unavoidable delays amounted to $2.29 per hour, nearly twice the entire hourly income of the horse team.

While it is the speed and the strength of the motor truck which fundamentally accounts for its ability to haul goods more cheaply than the horse, there are often other considerations which have a bearing on this result. Thus the compactness of a truck enables it to maneuver in a small space, and its ability to climb steep grades makes its use possible where horses could only be employed with great trouble and inconvenience.

Overcoming Handicaps. A most striking example of the adaptability of the truck to difficult hauling conditions is found in the work of excavating for the huge Ford Hospital in Detroit. The excavation for the main building covered a space of 620 by 50 feet, and two wings, one at each end covered an area of 250 by 50 feet. It was necessary to excavate to a depth of 5 feet over this entire area.

The contracting company first made use of horses and mules, figuring the cost of moving the material in this manner at $1.30 per cubic yard. They had not been engaged in this work long, however, before they saw that certain peculiar conditions demanded the use of motor trucks. Here are the conditions which surrounded this job:

In the first place, the ground was wet, and the narrow wheels of the wagons as well as the horses' hoofs sank in so deep as to hinder their progress. It was necessary, therefore, to build a plank platform running the length of the excavations. However, they found that a team of mules with a wagon behind occupied a great deal of space on the platform, not only due to the considerably greater length of the horse-drawn unit, but due

also to the fact that the mules were less easily maneuvered and hence required greater space. Moreover, because of the limited capacity for work of the mule teams, it was necessary to employ a large number of them, which, coming and going all the time, added greatly to the confusion and congestion in the excavation. In the second place the contractor discovered that he could not make use of quick-loading devices inasmuch as the mules required a certain period of rest while loading. In the third place he encountered a very troublesome difficulty when he discovered the mules could only with difficulty surmount the 20% grade which led from the excavation to the level above. He found it necessary to hitch on an extra pair of mules in order to haul wagons up the incline and he was continually obliged to build new platforms and inclines with a grade less than 20%. This used up valuable time and cost money. In the fourth place he found that he could not get enough teams to do the work.

Trucks Cut the Cost 50%. It was not long before a fleet of fifteen 5-ton trucks was installed in this work. The additional speed and strength of the trucks, their compactness and their ability to negotiate almost any grade by means of their low gears, all combined to cut the cost of moving the dirt by more than 50%. Following is a table showing the daily cost of operating teams and the cost of operating a 5-ton truck on this job and the work done by each.

Cost	*Capacity*	*Number of Trips*
Team $ 8.00	3 cubic yards	3
Truck 25.00	5½ cubic yards	10

As a result of this economy the cost of removing each cubic yard was reduced from $1.30 to 50 cents, making a saving on the entire job of $12,600.

A large woolen company cut its delivery cost in two by installing a 5-ton truck. The vehicle works between Lowell and Coblinsville, the railroad terminal being situated at the former place and the mills at the latter. Raw material is hauled to the plant and the finished product carried back for railroad shipment. The truck does work both ways.

By horse-drawn wagons it used to cost 70 cents per ton for this hauling. With the truck this figure varies from 28 cents to 40 cents per ton, the variance being due to weather conditions. The average is figured at close to 34 cents per ton, a 50% saving when compared with the figure of 70 cents per ton by horse.

Handling Loads in Cramped Quarters. The cost of handling and moving express in a terminal railroad station forms no small part of the total budget of an express company. While the traveler gains the impression of mammoth size as he surveys the enormous railroad terminals of a big city, the fact is that the space allotted for handling merchandise is often none too large. In most cases the express company must make use of every expedient for handling its business in its relatively cramped quarters. If the trucks used are compact, room can be saved; if speedy, goods can be handled and got out of the way, without being stacked up in the aisles and passageways.

Express companies rent their space, generally, from the terminal companies. This rent is high, and any device that enables a company to reduce its rented floor area or carry on an increased business without increasing this area, makes possible an important economy. In addition, there is, of course, the economy to be derived from operating the device itself, if it is more effective than former methods.

The American Express Company in Boston has its headquarters at the North Union Station. The floor space at the company's disposal is large. The business which this company handles yearly is also large. Moreover, this business has increased, while the floor area has not.

Industrial Trucks at Terminals. Between January and April 1912, this concern bought twelve electric industrial trucks. In June of the same year it bought two, and during the balance of 1912 it added eight more. From this small beginning the express company proceeded to add more trucks as their economy and usefulness were proved, until at present they operate a fleet of over fifty industrials under one roof.

These trucks have been equipped with drop-platform bodies. This design permits of the maximum carrying capacity in compact form. The lowered base of the body clears the floor by only a few inches. (Figure 168.) Thus heavy articles can be slid on or off without much lifting. The two raised ends are just the height of the baggage car floors, so that articles can be slid from the car without being lifted. Sideboards are provided, which can be attached whenever the load is bulky.

As a result of this installation great economies have been effected. It has been found that one of these trucks, requiring only one man to operate, does the work of two and one-half

hand trucks, each of which required two men to handle on level floors, and often four or five on inclines. With the considerable increase in express business, the labor charge has remained practically the same, while the merchandise has been handled more satisfactorily. The trucks carry greater loads than men could handle. They take up less room per ton carried. They are safer because of the automatic brakes with which they are equipped. Because of solid rubber tires, little damage is done to fragile merchandise. As the labor is not so hard, the operator can give more of his energy to handling the freight properly, and thus a higher grade of men can be obtained for the work.

Specific Uses of Industrial Trucks. The trucks operate at six miles an hour. They steer on all four wheels, and are able to maneuver in tight places. For instance, they have a turning radius of sixteen feet, but they can twine in and out between posts set only seven feet apart. (Figure 299.)

Recharging is effectively handled, by keeping four or five spare batteries constantly on hand. An overhead rail extends from the battery station to a distance out in the center of the charging room. From this rail is suspended a chain, at the lower end of which is a U-shaped shovel, the two arms of which point in a horizontal direction.

The battery of one of these trucks, constructed as it is largely of lead and other weighty material, is very heavy. To handle it by man-power would be dangerous. With this device, however, a battery can be removed and a fresh one put in its place in about two minutes. As these trucks average about 25 miles every 48 hours, which is just about the capacity of a battery charge, they can operate 47 hours and 58 minutes out of every 48.

A certain amount of express has to be hauled daily to the south station—a distance of some two and one-half miles across the city. Instead of removing this merchandise from the industrial trucks, and packing it into a regular commercial truck, it has been found practicable to run one of these industrial trucks already loaded, directly on to the body of the street truck, and transport both truck and load across the city. The wheels of the industrial trucks are locked by chains to prevent any possibility of their breaking loose and rolling off.

A double economy is gained by this procedure. Time is saved at the north station by eliminating the transfer of goods from the industrial to the street truck. The same is true in

FIGURE 298: Cutting down the delay where it is apt to be longest—at the loading point. Why hold up a truck with shovelers? This loading device enabled one contractor to take in $83.36 in one day with one 5-ton truck.

FIGURE 299: The electric industrial truck flits in and out, turns sharp corners, and weaves its way across a floor cut up by dozens of posts, some of them only seven feet apart. Its electric power permits of perfect control.

FIGURE 300: These trucks saved a New York brewer $10,092 in one year Their greater radius of effective action eliminated two stock depots which the brewer had been obliged to maintain when he depended on horses.

FIGURE 301: This "grab-bucket-digger," mounted on a scow, unloads coal from a barge and drops it into a hopper. A gate at the bottom of the hopper enables the loader to "feed" a 5-ton load onto a truck in thirty seconds.

reverse order at the south station, where otherwise it would be necessary to unload the street truck and pack the goods a second time, this time on a second industrial truck which would have to be requisitioned at that point.

$10,000 Saved in Nine Months! As an instance of the sometimes indirect manner in which motor trucks cut the cost of delivery, the experience of a New York brewer is well worth study. This concern, which previously used teams, installed three 5-ton motor trucks. It gave him the results represented by the figures below:

$44,459.00
34,367.00

The top figure represents the total delivery costs for nine months of the year 1913. The bottom figure covers the same months of 1915.

It will be noted that there is a big difference in the totals, $10,092, or 25%. This difference shows what the trucks saved over a system of horse delivery combined with freight shipment. In 1913 the company had no trucks and depended on draft animals and shipments by rail. The big reduction in the cost as shown in the 1915 figures followed the switch to the motor truck and modern delivery methods.

What accomplished this great economy? The superior speed and strength of the motor truck were fundamentally responsible, but the brewer points to an interesting phase of the matter which might otherwise have been overlooked. In former days the brewer had been obliged to maintain two stock depots, one located at Mount Vernon and one at Mamaronek; beer was shipped through to the two points in carload lots under the old arrangement and then distributed from these points by horse-drawn vehicles.

At both points it was necessary to maintain fully equipped stations with ten horses each, six wagons, three drivers, watchmen, stable men, superintendent, and clerks. There was also the matter of extra handlings. Beer had to be carted from the brewery to the railroad station, taken off and loaded on the platform, thence into the freight cars, taken off these at the end of the trip, and then put on the horse-drawn vehicles that completed the journey.

Two Branch Depots Eliminated. Now all the delivering is done from the main garage. (Figure 300.) The stations have

been rented for other purposes and in place of being a cause of expense to the company have become a source of revenue. Forty-one horses are maintained at the main stables where they are used in short haul and near-by work. Now that the horses are relieved of the strain of long hauls, they are able to give excellent results on the near-by trips for which they are better suited.

Each driver reports at 5:30 a. m. in the summer months. His load is fifty half-barrels, and with the aid of the helper the vehicle is on its way in half an hour. Except on the long hauls the trip is finished and the truck back in the garage by 4 in the afternoon. Work starts an hour later in the winter months.

One characteristic of the truck which enables it to compete so satisfactorily against the horse and wagon is its ability to stand punishment and to work continuously without a rest. The average business man has little conception of the amount of work which a truck can do when it is pushed. Methods of speeding the work and keeping the truck constantly busy, which, if applied to teams, would bring charges from a humane society, make for more efficiency when applied to the power wagon.

Delivering 578 Tons of Coal a Day! A 5-ton dump truck operated in New York City recently performed the feat of delivering 578 tons of coal in one day. The haul was short, being only about a quarter of a mile round trip. One hundred and fourteen trips were made.

Here was a condition supposed to be unfavorable to the use of motor trucks, inasmuch as it clearly involved short hauls. Due to the ingenuity and energy of the owner, however, conditions at both the loading and unloading points were made so favorable that the trucks were only held up for a matter of a few seconds at each place.

In this case the loading point was the coal barge in the river. The truck owner installed a special device which he termed a "digger," which, described simply, was a long crane fitted with a clam shell scoop. The unique feature of this "digger" was that it was mounted on a separate scow belonging to the contractor (Figure 301), and thus was not only available wherever a coal barge might be anchored, but could be maneuvered with respect to the barge which it was unloading. The scoop goes down into the barge and literally "cleans it out" at the rate of eight tons every fifty seconds. The equipment is so arranged that the "digger" can manipulate the coal in and out of any place,

FIGURE 302: This contractor found that it is more profitable to use a trailer when the streets are congested than when they are clear. He therefore worked his truck alone by night, and with the trailer attached by day.

FIGURE 303: Notice the wagon at the right. It is not in reality a wagon, but a semi-trailer, the front end of which is mounted on a pair of wagon wheels. When the truck returns, it takes on this loaded trailer in exchange for its empty one.

FIGURE 304: Here tracks are laid on a semi-trailer, more tracks lead under the street, and buckets on wheels carry away the excavated material. This enabled one contractor to excavate a subway in New York without closing the street to traffic.

FIGURE 305: Interchangeable storage batteries have greatly lengthened the radius of action of electric trucks. A small, three-wheeled floor truck rolls under the exhausted battery, lifts it out, and replaces it with one freshly charged.

swinging the load over four boats should conditions at a wharf make this necessary. It swings its load of coal over a hopper temporarily erected on the wharf, and from the hopper each motor truck gets its load in turn in less than thirty seconds' time. The truck then completes the record of speed by a quick run to the destination where the power dump controlled by a lever from the seat, permits instant unloading.

Why Trucks Replaced Horses. It is because of results like this that the owner is getting away from horses. Formerly he had 285. Now that number has been reduced to 110, and those that become unfit for service are not replaced. In his own words this truck owner presents his conclusions:

"Getting rid of horses will give me ten years more of life. They were a constant source of worry. Something was always going wrong. They got sick, collapsed, or died when you wanted them most. Hot weather or snow put the animals down and out.

"With the trucks we have a comfortable, scientific delivery. We figure on jobs that we would not tackle with horses. We go to places beyond the reach of horses, and thus get profitable, new business. Brooklyn and Staten Island are easy. On a rush job we once covered 164 miles in eleven hours on a job at Flushing. It is a joke to consider horses ever doing this."

Better Delivery at Half the Cost. How a dry goods store cut the cost of delivering packages from an average of 10 cents to less than 4¼ cents apiece is told by a Toledo concern. This company used a light delivery car equipped with pneumatic tires, capable of a speed ranging from twenty to thirty miles per hour. In 18 months this car delivered over 71,000 packages.

It was put on a city run in November. During its first month it carried 5,066 packages at an average cost of 2.75 cents per package. During the first six months it delivered 31,609 packages at an average cost of 3.34 cents per bundle.

In May it transferred to a suburban route, which covered the outskirts of Toledo, where the problem was more nearly similar to that of the merchant in the smaller town. During the first month delivery cost 6 cents per package. From that month on the number of deliveries began to climb steadily, until, in December, 5,442 were made at a cost of 3.25 cents.

During the last twelve months 39,825 bundles were delivered, with an average cost of 5.3 cents, not only for small packages, but for articles ranging in size from a package of pins, or needles, to pianos, talking machines, bulk furniture, refrigerators, sewing machines, and the like.

Included in the cost of delivery are 6% for interest on the investment, 3% per month depreciation on the original cost of the car, expense of delivery superintendents and assistants, license, insurance, driver's and helper's salaries, gasoline, oil, and repairs.

This motor has taken the place of two horses and a wagon. With wagon delivery a horse is used but half a day. One horse makes the morning run and the other makes the afternoon run. Delivery by this method averages 10 cents per package. The motor averages about 52 miles per day, or more than 16,000 miles per year, an increase which is figured annually at more than 10,000 miles over the horse-drawn method.

Nine Trucks Saved $125,000 a Year! In the mountain wilderness of northern Maine a gigantic dam has been built across the gorge of the Ripogenous, which will store up the water of the west branch of the Penobscot River, and the waters of the Ripogenous, Cantan, and Chesuncook Lakes, in the fourth largest reservoir in this country.

A large paper manufacturing concern had discussed the project years ago. As an engineering feat it was entirely practicable. But always the problem of transporting the material stood in the way. The location of the proposed work was fifty odd miles from the nearest railroad. There was no wagon road. The project presented serious complications.

To build a railroad would cost on the average $30,000 a mile, and when the dam was completed this enormous investment would become unproductive. To build a private wagon road would be considerably cheaper—possibly $6,000 a mile—making the total in the neignborhood of $250,000.

But the wastefulness of horse-hauling for such distances was tremendous. Four horses would be required to a "train," and such a team, if worked to its capacity, could make but two round trips a week, carrying a little over three tons to a load. A truck, on the other hand, working sixteen hours, could make two round trips a day, and carry five tons. So it was decided to build the vehicle road and use trucks. These figures show the relative power of the 5-ton truck against four-horse teams:

	Number of Trips Daily	*Tons Carried*	*Tons Delivered Daily*
5-ton truck	2	5	10
4-horse team (1-ton)	½	3	1

From this table it will be seen that one 5-ton truck replaces not only ten teams but forty horses! This may stagger the belief of the city dweller who is used to seeing a truck replace three or four horses at most. But consider the enormous power of a truck when operated at its full effectiveness.

The equation is: Speed × Load = Work. Taking the draft horse or mule as a standard, and representing his speed of two and a half miles, and his load of one ton, as unity, we may fill in the equation for the horse as follows: one unit of speed × one unit of load = one unit of work.

The 5-ton truck has a speed of ten miles and carries five tons. It has, therefore, four units of speed and five units of load as compared to the horse. The equation for the truck becomes, therefore, four units of speed × five units of load = twenty units of work.

Thus a 5-ton truck, when making use of its maximum speed and load-carrying capacity, can do the work of 20 horses. But how was it possible for the truck purchased by the paper company to replace forty horses? Simply because it was driven 16 hours a day. The horse can scarcely stand eight hours on this type of work.

By the use of nine 5-ton trucks, upward of four hundred horses were eliminated. In a year three trucks saved in the neighborhood of $125,000. In other words, in two years these nine 5-ton trucks will make the road a gift to the enterprise.

PART IV

BUILDING NEW BUSINESS WITH YOUR MOTOR TRUCK

CHAPTER XXX

HOW MOTOR TRUCK ASSOCIATIONS HELP TRUCK OWNERS

A CERTAIN milk dealer operated a 3½-ton truck out of Cooperstown, N. Y., through some of the near-by rural communities. One day he received notices from the highway commissioners of two of the towns on his route forbidding the operation of his truck over the roads in their townships.

The notices were exact duplicates, and were drawn up in formal phraseology. They stated in their conclusion:

> **You are hereby forbidden from in any way drawing, propelling, transporting or otherwise operating said gasoline auto freight or milk truck upon any of the said highways or bridges in said town.**

Here was trouble, indeed. It meant that the milk dealer would be ruled out of those two towns or would have to buy a smaller truck, or use a horse and wagon, and any one of these alternatives would upset his delivery plans or cause him a financial loss.

What an Association May Accomplish. But it so happened that this dealer was a member of a motor truck association, to which he referred his trouble at once. The association had not only established a committee to look after legislation affecting truck owners, but also had in their employ a law firm which specialized in this branch of the law, and whose advice could be had by any member without charge. Their lawyer at once investigated the case and found out that the highway commissioners of both towns had no authority to act as they did. Armed with this information the milk dealer declined to accept the edict of the commissioners and continued to operate his truck as before without further interference. He had been saved trouble, expense and interruption of service by the prompt action of a motor truck association.

This is only one incident out of a hundred which might be cited to show how an energetic association of motor truck users

can protect its members from the menace of unreasonable, and often dangerous, legislation.

One Example of Foolish Legislation. Prejudice and ignorance are constantly at work producing rules, regulations, and ordinances which, if not combated, might cripple the operation of motor trucks in many localities. In Chicago some theorist conceived the idea that motor trucks should be equipped with fenders. If such equipment should be the means of saving life, no one would have opposed it. But, as a matter of fact, truck fenders are worse than useless, and in addition greatly increase the difficulty of maneuvering in traffic and make for congestion, delays, and increased cost of deliveries. The local motor truck association fought the measure, demonstrated the uselessness of the fender, prevented the enforcement of the law and defeated subsequent attempts at further legislation of that nature.

In Chapter XXXI we have discussed the numerous attempts which are being made to enact legislation limiting the size, speed, and weight of trucks used on the highways. Most of these proposed enactments are dagger points directed at the individual truck operator. Some of them, if carried out, might have the effect of changing hundreds of profitable truck installations into losing ventures. Some of them which have been carried out have had the effect of making certain localities unprofitable fields for the use of motor trucks. These dangers are real, and they concern the individual operator more than he believes.

Why Associations are Helpful. But the average individual operator is powerless to combat such dangers. He does not possess the money, the time, or the influence to make his opposition effective. Public officials generally do not pay much heed to the protests of single individuals. But the business of motor truck transportation is made up of individuals; it is great only in the aggregate. The public does not conceive of the motor truck owners of a state as being a special interest, because in fact they do not constitute a special interest. Taken all together, they may represent as much capital invested as a railroad, but, unlike the railroad, they do not speak with a single voice, but with separate and individual voices.

It is this necessity of combining their many individual interests into one strong interest that has made truck owners in many localities join forces in an association. Protection has been and continues to be the chief benefit. But other advantages often

result. What a good motor truck association can accomplish for its members is nowhere better realized than in the performance of the Motor Truck Club of America, with headquarters in New York. The following table gives in compact form the achievements of this association in six years of its existence:

Fostered cooperative effort between manufacturer and user by holding a convention, attended by all interests, in Detroit in 1914.

Opened practically all docks and piers in New York City to gasoline trucks. In the early stages of the industry thy were excluded.

Worked and planned with Dock Commissioner and steamship officials to expedite hauling of freight on piers and docks.

Prevented an increase in ferry rates of 27%.

Effected substantial savings for its members through its insurance plan.

Studied the paving situation, and continually fought for pavements suitable for motor trucks.

Prevented passage of McAneny ordinance taxing all vehicles in proportion to tire width.

Prevented passage of Myers ordinance limiting size, weight, and speed of trucks.

Through demonstrations cooperated with the Street Cleaning Department to obtain more efficient equipment, thereby enabling it to open streets promptly after heavy snows.

Through demonstrations cooperated with the Police Department to determine what speeds are practicable.

Demonstrated to the Police Department that front and rear fenders are impracticable.

Secured the cancelation of orders ruling certain trucks off New York and New Jersey state highways.

Secured the defeat of bills aimed to greatly reduce the allowable loads and speeds of rubber-tired motor trucks.

Obtained elimination of the personal tax or commercial vehicles.

Prevented doubling of present license fees as war revenue measure.

Made practice runs which successfully demonstrated the availability of heavy trucks for army transport.

Answered the emergency call of the government by transporting baggage and equipment of the Seventy-first Regiment to a camp 67 miles upstate.

These problems, it should be observed, are your problems. The association takes them off your hands and attacks them in a way which you as an individual could never do. But if they were neglected, if there were no association, truck owners would suffer inconvenience, delays, and a very real money loss.

No better idea of what an association really means to the truck operator can be gained than by reading the items in such

a table as we have presented above. Let us present another table of "business accomplished," taken from the report of the Motor Truck Owners' Association, in Chicago:

"Prevented the enforcement of, and defeated in the lower courts, the vicious motor truck fender ordinance; and defeated subsequent attempts at further similar legislation.

"Secured the amendment of the Automobile Parking Ordinance so as not to unduly interfere with motor trucks.

"Secured the amendment of the Street Car Loading Zones Ordinance so as not to unduly interfere with motor trucks.

"Secured the amendment of the Cab-Stand Ordinance to permit the use of such space by trucks.

"Proposed, and secured the passage of, 'Safety first' ordinance requiring stop at boulevard crossings.

"Supported ordinance requiring vehicles to stop before emerging from alleys.

"Secured amendment of a new auto locking ordinance to exempt motor trucks.

"Secured the postponement, for careful consideration and investigation as to reasonableness, of:

(a) Speed governor ordinance
(b) Trailer tire ordinance
(c) Load projection ordinance

Opposed:

(a) The resurrection of the 8-mile speed limit ordinance
(b) A proposed ordinance to require speed indicators on trucks
(c) The revision of the wheel tax schedule for trucks
(d) A proposed ordinance reducing the permissible maximum load for trucks
(e) An ordinance increasing the license fees for automobile public carts. Contested its validity in the lower courts, and appealed it to the Supreme Court

"Given necessary attention to improve traffic conditions and to forestall illegal or unreasonable action and safeguard the interests of motor truck operators, to the following proposals:

(a) To create a Vehicle Section in the Police Department
(b) To prohibit traffic vehicles on street car tracks
(c) To license standing at curbs
(d) To mark pavements at street intersections
(e) To adopt mechanical traffic signals
(f) To regulate crossing of streets by pedestrians
(g) To regulate street obstruction by building materials, and the like
(h) To pay for street paving from wheel tax fund
(i) To require garages to keep vehicle records
(j) To regulate location of garages
(k) To regulate gasoline storage

"Defeated proposal to substitute for the present system a schedule of state registration fees for trucks based on load capacity.

"Opposed, pending careful and thorough investigation, proposed state enactment prescribing weights of loads, tire dimensions, maximum speed, and so on, for motor trucks.

"Opposed proposal to prohibit spotlights.

"Established a monthly magazine for the information of the membership.

"Established a bulletin service for the prompt dissemination of important information.

"Successfully fostered cooperation and friendly relations with legislative and executive authorities.

"Established cordial relations with various commercial organizations whose members are interested in matters affecting motor truck operation.

"Increased the membership approximately 320% over last year."

Associations for Smaller Cities. If the truck operator lives in one of the larger cities, he will probably find a motor truck association already formed which he may join. If he is located in a smaller center, he will probably have the opportunity of helping to form one. In either case, it will help him to know something of the workings of such associations, how they are organized, their aims, their development, and the difficulties which they must overcome. In this connection a brief history of the Motor Truck Club of America will be of interest, because this association has unquestionably had the longest experience, has tackled more difficult problems, and achieved a greater measure of success than any similar organization in the country. Present activities would indicate that its real work has just begun.

How the First Club was Organized. From a beginning in 1910 of only sixteen members, this association has grown to a membership of over four hundred. The charter members were motor truck salesmen who daily gathered round a luncheon table and exchanged ideas on problems affecting their own business. At first the club was purely social, with vaguely defined qualifications of membership and no dues; then it became a mixed club with nominal dues, which were very irregularly paid; at this time its chief function was to help the sale of trucks. After the club had been in existence a little more than four years, it had grown to such an extent that it was deemed expedient to incorporate it, and, accordingly, a charter was secured under the laws of New York, on January 17, 1914. The growth of the association for the first five years of its existence is shown in the chart reproduced in Figure 306.

About this time the question arose which is bound to come up in associations of this kind, whether active membership should not be restricted solely to owners of trucks, thereby excluding "trade" members whose interests could never be identical with those of truck operators. It was finally decided that its greatest field for usefulness would lie in being an organization of owners and operators, rather than of truck makers and salesmen. To that end, therefore, the new constitution

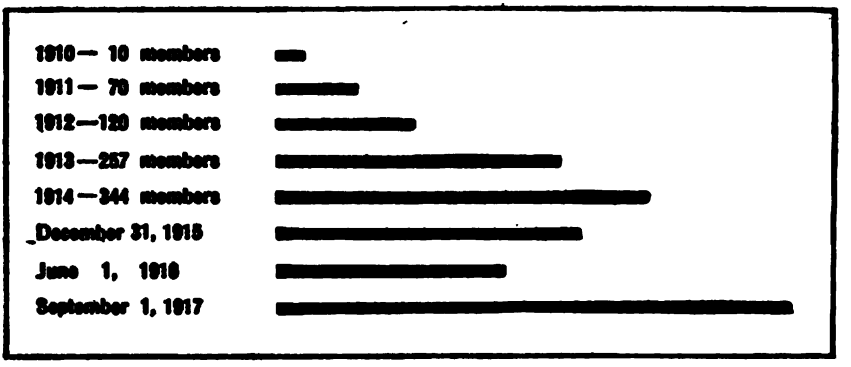


FIGURE 306: How the Motor Club of America grew during the first five years of its existence is shown here. The 16 salesmen started what was destined to be the strongest and most influential association of its kind in this country.

was framed, and, by amendment, in July, 1915, this change in membership was still further emphasized by making it exclusively an owners' body, except for the loyal "trade" members who had fostered the organization through its earlier years, and who were retained on the rolls.

At the same time, the system of dues was radically changed to meet the growing financial burdens of the organization—the annual dues being raised from $10 to $25. Naturally, under these conditions, the membership declined somewhat in numbers, but the relative proportion of owners increased, while the financial condition of the club was also improved.

The Question of Trade Members. Again the question of membership came to the fore. Should "trade" members be admitted or not? The ideal association, would be one composed entirely of truck owners, having the same problems to solve, the same interests at stake—and "nothing to sell in meeting."

But there was another side to the matter. Trade members, after all, were generally energetic members. The fact that they

were salesmen often qualified them all the more to push the association idea ahead, to "sell" it to truck owners and the public in general. It was a group of salesmen, not truck owners, which originated the association. What if trade members did have something to sell? It was an easy matter to prevent them from discussing their wares at their business meetings. And, again, these trade members were generally "on hand" when important

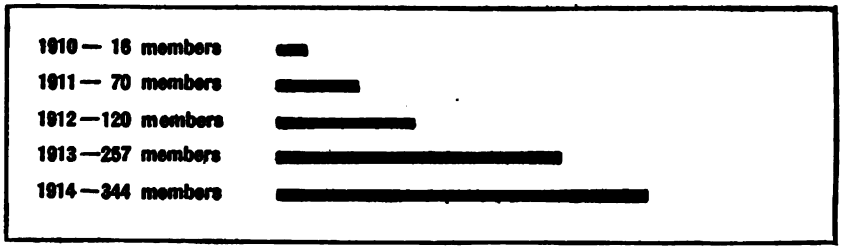


FIGURE 307: Then came a question of policy which all associations of this kind must decide sooner or later. Should "trade" members be allowed active membership? "No," voted the club in 1915, but later results proved this move unwise.

meetings were scheduled; they appeared in force at Newark or Albany to protect motor truck interests, when many large fleet owners stayed at their desks.

The narrow point of view gave way to the broader one. What if the trade member does have an axe to grind? Frequently he has more at stake in the welfare of motor truck transportation than many truck owners put together. And, as a club worker he proved he could keep silent about his own special interests. So the spirit of the association was broadened, and the club invited not only truck owners but anyone genuinely and actively interested in the promotion of conditions favorable to motor vehicle operation. Its new growth is shown in the chart reproduced in Figure 307.

How this association went through the critical evolution in the character of its membership is shown in the following excerpts from its constitution:

SECTION 1—The membership shall be divided into three classes: active, sustaining, and honorary members.

ACTIVE MEMBERS shall be corporations or firms, represented by one member; or individuals who are owners or users. In the case of firms or corporations, officially designated representatives only shall have the right to vote.

A SUSTAINING MEMBER shall be any person, firm or corporation contributing fifty dollars ($50) or more to the treasury of the club, aside

from its regular membership fee.

HONORARY MEMBERS may, upon recommendation of the Board of Directors, be elected by a majority vote of members present at any regular meeting. Honorary members shall be entitled to all the privileges of active members of the Association, except the right to vote or hold office.

BY-LAWS

ARTICLE I

Membership

SECTION 5—Owners or operators of motor trucks only shall be eligible to election as active members from the date of passage hereof. Manufacturers of motor trucks, dealers or accessories men shall not be eligible to election as active members from the date of passage hereof.

ACTIVE MEMBERS shall be corporations, firms or individuals who are owners or operators of motor trucks, or who are otherwise in accord with the objects of the Club and desire to enjoy its membership privileges; each such member may be represented by one or more memberships.

A SUSTAINING MEMBER—To be eliminated.

HONORARY MEMBERS—To be retained.

SECTION 5—Not to conflict with Section 1 of Constitution in its new proposed form.

The Club's Work for the Future. And now, with its growth well established, this association is a model of what may be achieved by the vigorous cooperation of truck owners and all persons interested in motor truck transportation.

We must not overlook meetings frequently held, at which papers are read by men who are experts in some phase of motor truck transportation. Such papers are generally followed by open discussions which enable the individual operator to solve his own problems by the help of expert advice.

But what it plans to do in the future is equally inspiring. For, after vigorously combating dangers from without, it finds time and ability to do constructive work within; such as providing expert advice to all its members on those problems which affect their daily profit, such as loading and unloading, delivery systems, selection of equipment and keeping cost records.

Here is a list of the tasks this association plans to perform in the near future, work which, but for the intervention of this strong association with its committees, its legal counsel, its experts, and its united strength, would fall heavily on the shoulders of individual truck owners:

Watch and direct legislation in both city and state
Obtain proper uniform traffic ordinances
Obtain equitable ferry rates
Find means to reduce the present burdensome insurance charges

Push proper paving
Expedite traffic
Obtain open streets immediately after heavy snows
Keep streets clear of obstructions incident to construction work
Work for construction of vehicular traffic tunnels under the Hudson River
Perfect uniform methods for loading, unloading and handling freight
Establish bureaus to care for the interests of the different classes of members
Standardize and instruct in cost accounting
Cooperate in the present campaign for national preparedness
List all trucks available for government service, emergency and otherwise
Look after the general interests of all its members

In order to conduct the affairs of the club in a satisfactory manner, it has secured the services of one of its former presidents, Mr. Theodore D. Pratt, who acts as an executive secretary.

It will be interesting to compare the statements of three important associations with regard to the objects of each.

Chicago.—To further the interests of motor truck owners in the City of Chicago; to afford a means for united action; to promote conditions favorable to the efficient and economical operation of commercial motor vehicles.

New York.—The object of this club is to advance the interests of the motor truck industry and to promote and further the use of commercial vehicles.

Philadelphia.—The objects of this association are to advance the interests of the motor truck industry and to promote and further the use of commercial vehicles, to afford mutual protection to its members and to the public.

How the Philadelphia Motor Truck Association was started is told by its secretary as follows:

"The Motor Truck Association was first started by a number of salesmen getting together; this fell through. The second time it was proposed as an addition to the Philadelphia Automobile Trade Association, but this did not work out. The third time it was actually put on its feet by getting thirty of the dealers and branch managers together and organizing the Motor Truck Association of Philadelphia. Then these dealers and branch managers put their salesmen in as associate members, they becoming the proprietary members of the association. Or in other words, we found, by starting with the dealers and branch managers, we could form a real organization."

The benefits of associations of this kind are so obvious that the only wonder is that every truck operator does not join one where it is already formed, or help to form a club where one does not already exist. As a matter of fact, such organizations, in looking after the interests of their members, are generally fighting the battles of those truck owners who are not members. Hence they both need and are entitled to the support of all.

A Strong Appeal. "Get Together," says the Motor Truck Club of America in its appeal to truck owners. "The benefits which you will get from dues paid into the Motor Truck Club would cost you manyfold if obtained singly and alone. In individual effort there is weakness. In organization there is strength. Let us, therefore, organize. Let us get together. Let us bring the organization of the Motor Truck Club up to the point the tremendous growth of this industry demands."

The appeal is well put. If the 400,000 motor trucks in this country belonged to one company, there is no question that its fair demands would be heard. It is the task of every business man who operates a truck to advance the cause, not in an actual combination of interests which, of course, is impossible and undesirable, but rather in a concert of action by means of which it will be possible to demonstrate to legislators and highway officials, as well as to the community served by motor trucks, the true size of the motor truck industry, and, in accordance with the importance of the question, to get a fair hearing for fair demands.

CHAPTER XXXI

HOW TO MEET UNREASONABLE LEGISLATION

HAS the motor truck a right to use the public roads of a state, city, or town? It sounds like a foolish question. Of course it has. But suppose you, as a truck operator, received notice one day, *not* forbidding you to operate your truck on the public roads, but stating that you must equip it with tires twice or three times as large as your present equipment, cut its speed in two, and reduce its width, height, and length by a third. Suppose that under such conditions you could not possibly operate your truck at a profit. Would that be equivalent to ruling your truck off the roads?

This question, in one form or another, is coming to the attention of thousands and even tens of thousands of truck operators as city, state, county, and town officials are busying themselves making rules and regulations regarding the use of roads by motor trucks. It is well for the truck owner to post himself on the circumstances which give rise to this legislation, for his interests may be jeopardized, and if such legislation is without warrant or justification, he should be in a position to attack it in an intelligent and forceful manner.

Stating Both Sides. Trucks have certain rights; but so have roads. If we regard the motor truck as a public utility, it is the duty of the state—which is the public—to provide the necessary means for its use. But roads have limitations and some roads are easily damaged by heavy trucks, and need protection against them. Yet, should not roads be provided, adequate to carry the heaviest truck which is in general use by the public? This would cost an enormous sum of money, and would take years to accomplish. On the other hand, the advent of the automobile sounded the death knell for thousands of miles of water-bound macadam roads, which had to be rebuilt with a

different kind of surface to meet different conditions. True, and possibly the roads of today should be rebuilt to withstand heavy motor truck traffic, but in the meantime shall we not limit the speed and weight of motor trucks so that they will not unduly damage the roads we have today? Undoubtedly we should, but let us take care how far we go with those limitations, for if they are too strict they will result not in regulating but in destroying motor truck transportation.

How far, then, shall we go? That is the crux of the problem. The necessity for regulation of some kind is evident. To fit all or even half the roads of this country to stand the heavy motor truck traffic of the day would be an impossible task even in a dozen years. The Chief Highway Commissioner of the State of Massachusetts recently wrote:

"To build our main lines in the country so that they could carry these heavy loads would mean, at the very lowest estimate, 2,000 miles of road, and would mean $40,000,000; this alone for the State of Massachusetts. To make all the roads in the state able to carry the travel, would mean something considerably in excess of half a billion dollars, so you can easily realize that this cannot be done in any small number of years, as it would take one-fifth of all the wealth that is assessed in the State of Massachusetts to do it."

How should motor truck transportation be regulated, to protect the interests both of motor truck owners and the public? This question came up in Europe before it aroused discussion in this country. Three great road congresses were called, international in their character, for the purpose of settling this very vexing question. The conclusions reached were surprisingly similar, and are presented in the table below:

Proposed by	Speed Limit, Miles per Hour	Weight on heavy loaded axle, pounds	Weight per inch width of tire, pounds
Paris Congress 1908	10 to 16 6.5 to 10	8,800 11,000	840 (usual diameter) 840 (" ")
Brussels Congress, 1910	10 6.5	8,800 8,800-15,400	840 with 39.4 inches diameter
London, 1913	10	12,100	840 Solid Rubber, none less than 30 in., and rubber

About the same time that these recommendations were being drawn up by the London conference, the state of Massachusetts enacted road laws based upon the findings of these European conferences. The main features of the Massachusetts law are noted in the following table:

Proposed by	Speed Limit, Miles per Hour	Weight on heavy loaded axle, pounds	Weight per inch width of tire, pounds
State of Massachusetts	15, 6 with steel tires. 12 with rubber tires	Over 4-ton Over 4-ton Over 6-ton	800 800 800

The Massachusetts Highway Commission was the first in this country to investigate this question thoroughly, and the legislation which they recommended and which was enacted has the reputation of being a thorough and comprehensive treatment of the problem.

Unfortunately, however, such sound and reasonable legislation is not always the rule. Other states have passed laws so strict and narrow that motor truck owners have suffered not only severe annoyance but financial loss as well. Prejudice and ignorance are always at work. Not all highway commissioners or state legislatures go to the trouble of conducting such exhaustive and impartial investigations as those made by the Massachusetts Legislature, or the Paris, Brussels, or London conferences. Moreover, it should be observed that regulations of this kind proceed often from many sources, state, county, city, and town commissioners frequently taking a hand; and while these lesser commissioners are limited in their power to make laws, they often make regulations, which cause annoyance to the truck owner.

The Real Danger in Adverse Legislation. The operator of motor trucks today is faced by a real danger which it would not be wise to minimize. Let us consider a concrete example. In 1917, a certain eastern state attempted to pass legislation regulating the speed, weight, and tire width of trucks. This legislation was not simple as in the case of the Massachusetts law, but it included some twenty-odd sections. There is no better way of bringing home to the truck owner the menace of unfair legislation than to cite some of the articles in this proposed law.

A. "That all commercial vehicles or trucks should be equipped with sealed governor, the speed to be regulated as per schedule attached hereto.

B. "That not more than one trailer shall be allowed to any vehicle or truck; that in every case said trailer shall be equipped with rubber tires.

C. "That all commercial vehicles or trucks shall carry a spare wheel so as to avoid the possibility of any part of the steel rims coming into contact with the surface of the road, should the rubber tires become damaged.

D. "That all drivers of commercial vehicles or trucks shall carry way-bills for each load; said way-bills to show the gross and net weight carried."

The first two of these articles are certainly unfair, but the last two are absolutely absurd. The article with reference to carrying a spare wheel imposes a hardship away out of proportion to any benefit which may be derived from it. The article with reference to carrying way-bills for each load was so ridiculous that some of the newspapers drew cartoons of the idea showing truck drivers with adding machines and ledgers stopping on the road and computing new way-bills and new weights occasioned by having just made a delivery at a near-by store.

Successful Methods of Meeting Adverse Legislation. If legislation of this type is advanced by state officials, what can be expected of the thousand and one county and town commissioners who delight to make laws under the guise of ordinances. Obviously the truck owner must protect himself against unreasonable legislation of this character. How can he best do this? Here are eleven ways gathered from the experience of several truck owners, members of motor truck associations, lawyers and "trade" representatives who have fought unfair legislation in various parts of the country.

1. *Roads Should be Built to Accept the Standard Traffic of the Day.*—Before horse wagons were used, we had "trails." When wagons came on the scene, they damaged these trails, which had to be replaced by "graded dirt roads." But the passenger automobile soon tore these roads to pieces, and it became necessary to build better roads, supplying them with a harder, more durable surface.

Why were these expensive changes made? Because it was recognized that the wagon, and later the passenger automobile constituted a standard form of traffic. They were not exceptional or freakish, but represented a type. Now the motor truck is here, heavier than the passenger automobile, and it requires still another quality in our roads—that is, a strong foundation. If motor trucks were an experiment, if there were only a handful of them, some carrying 1-ton loads, others carrying 40-ton loads, we might be justified in saying: "This is not a standard or accepted form of traffic, but is an innovation or experiment, and we are justified in guarding our roads against it until such time as the public indorses it and uses it as a standard form of transportation."

But, happily for the truck owner, the motor truck has already established itself as an accepted form of transporting merchandise,

on our highways. There were about 300,000 motor trucks at the beginning of 1918. Moreover, the size and weight of the motor truck has passed the freakish stage, when anything might be expected. It is as much a standard vehicle as the wagon, each within its own limits.

So it follows that the damage which is being done in some sections should not be charged against the motor truck, but rather against the road which has not been designed to sustain it. Of course, as a measure of expediency it is permissible to frame regulations which shall prevent the abuse of roads by any unusual employment of these standard vehicles. It may be permissible in the case of roads which the state has been unable to improve as yet, to enforce special regulations for the time being. But it should be understood that such regulations are framed in a spirit of compromise, and as withholding temporarily a privilege with the consent of the truck operator to whom it is due.

2. *Regulations Should be Based on Knowledge of the Effect of Trucks on Roads.*—Where it is necessary to make regulations limiting the size, weight, and speed of trucks, these regulations should not be based on guesswork, but on facts.

It is not right for any commissioner to frame offhand a drastic ordinance unless he can support it by facts. For, as we have said, the standard motor truck, one that is not exceptional in weight or design, has a fundamental right to the road, which may be suspended only by permission, so to speak. The burden of proof rests with the law maker.

But this proof is hard to secure. In the nature of things it is difficult to determine the precise effect of motor truck traffic on roads. It requires a searching investigation, which the average highway official does not have the means of making.

In view of this general lack of precise information, there is often something absurd in the practice of highway officials in drafting laws which specify down to the last pound the load which it is permissible to carry on the highways. Thus it sometimes happens that a law is passed which so limits the weight per inch of tire width as to make it perhaps only ten or fifteen pounds below that sanctioned by the guarantee of the tire maker. Such a law may indeed be considered troublesome and vexatious, having the effect as it does of compelling the entire body of truck operators in a locality to discard their present tire equipment. At this point truck owners can bring home the argument that inasmuch as highway officials by their own admission do

not know within two or three hundred pounds the effect of weight per inch of tire width on the road, they are not justified in determining upon an arbitrary figure which, by the insignificant margin of fifteen or twenty pounds has the effect of upsetting business interests amounting to hundreds of thousands of dollars.

3. *European Investigations Should be Studied.*—In view of the difficulties which prevent the average official or highway commission from investigating the effect of motor truck traffic on roads, the conclusions of the three international road congresses at Paris, Brussels, and London, are entitled to much consideration. It is to be presumed that these conferences were widely attended and that every effort was made to reach a solution to the question at issue, which was, "What is the effect of trucks on roads, and what regulations is it wise to place limiting the weight and speed of trucks?" One of the most important items is that regarding weight permitted per inch of tire width. In fact, this is the matter which has given most concern in legislation which has been and is being proposed in various states of this country. It so happens that all three of these congresses, held at different places and in different years, decided this point and agreed unanimously that the limit of 840 pounds per inch of tire width would be reasonable and would give sufficient protection to the roads. It is obvious that when local highway commissions suggest such absurd limits as 500 or 450 pounds per inch tire width, they fail to take into consideration the experience and the testimony produced at these international congresses. While the road conditions may be different in America, it should be observed that it is the duty of the state to provide roads capable of sustaining motor truck traffic, and that the conclusion of the European congresses demonstrates that across the water they have succeeded in doing so. Surely this country can do as much as Europe has done.

4. *Watch the Steel Tire.*—In the matter of road legislation, the truck is virtually in competition with the wagon. While it is the truck which is more severely regulated, it is questionable whether or not the wagon tire is the more destructive to the road. It is well for the truck operator to be posted on the relative effects of the rubber tire versus steel tire on the road, inasmuch as in pleading for more favorable legislation it is often very much to the point to show that wagon tires are more destructive to the road than tires of rubber. This can easily be proved in the following way:

a. Theoretically the steel tire bears upon the road with only a line contact. This can be illustrated by taking a coin and setting it on its edge on a desk. The rubber tire, on the other hand, flattens out considerably, and has an area of contact having both length and breadth.

b. On uneven roads or roads having a pronounced crown, a steel tire will bear on the road only on the high spots. It makes no difference, therefore, how broad the steel tire is made. It may still cut a gash in the road by reason of the fact that only a small percentage of its width touches the road. The rubber tire, on the contrary, is subject to considerable change in shape and adapts itself to a large extent to irregularities in road profile.

c. Steel tires, being very durable, can be made in narrow widths which will sustain enormous loads without inviting injury to the tire. Such tires often cut deeply into the road. Rubber tires, however, have to be designed as to cross-section very strictly according to the loads they are meant to carry. For, if this is not done, they will go to pieces and cause the truck owner a serious financial loss. The user of rubber tires, therefore, in protecting his own interests, must employ a tire which by reason of its width, does less damage to the road surface.

d. Perhaps the most important phase of the controversy is the damage done by the impact of the steel tire. A tire rolling along the road is meeting innumerable obstacles, either elevations or depressions, and it delivers a blow to each of these obstacles as it meets them. The whole issue, therefore, resolves itself into a question of the effect of a blow made by steel as compared to that made by rubber. On one hand we have one of the hardest substances known, on the other, the softest cushion made of solid matter. It is possible to crush a stone by relatively light blows with a steel hammer but how long would it take to crush a stone swinging a heavy mallet made of rubber!

5. *Discourage Overloading.*—If the truck is loaded in such a manner that it does not injure its own tires, it is not likely to injure the road. It is the practice of many truck operators, however, to overload their trucks. This, of course, has the well-known effect of ruining the tires, but it also has the effect of damaging the road. Several cases have come to our attention where 5-ton trucks carrying eight or nine tons have broken through the surface of streets as well as culverts and bridges. One or two instances of this kind of abuse have more effect in stirring up highway officials than all of the ordinary wear and

tear of the remainder of motor-driven traffic. As a result of such damage, highway officials have drafted laws reducing the weight per inch of tire width to a point less than that reached by the guarantee of the tire makers, even though these officials themselves admit that if the trucks carried loads not in excess of the weight indicated by the guarantee of the tire makers, probably no harm would be done to the roads. The few cases of overloading may, therefore, occasion a penalty which will fall heavily on the entire truck-using public of a given community.

6. *Urge that Tire Width be Measured at the Base.*—While most states in their legislation specify a certain load per inch of tire width, they do not always make it clear whether tire width is to be figured by the actual contact of the tread with the road, or whether nominal size, which is the width of the tire-base, should be taken as a basis. While manifestly it would be desirable to ascertain the exact width of tread which comes in contact with the road, there are several considerations which make this impracticable if, indeed, not impossible.

In the first place practically every different make of truck tire has a different profile. Some makes have treads with square corners, some treads with round corners and some have rounded treads. No two makes of tires have the same width of contact with the road for the given size. Moreover, it is difficult to measure the actual contact of a given tire with the road, and even if this were possible, it would be necessary to make additional measurements for different loads inasmuch as, of course, the tire has greater or less contact according to the load which it supports. Again, some tires have softer compounds than others and have a greater spread under compression.

There is another variable which is even more troublesome. This is the constantly changing width of the tread due to the wearing down of the tire. Every thousand miles of wear—in fact, every hundred miles of wear, means a different area of contact and further adds to the difficulty of ascertaining with exactness the width of tread in contact with the road.

On the other hand, there is a measurement easily available and practically uniform for all tires. This measurement is the width across the base which corresponds to the nominal width of the tire. For all practical purposes this will serve just as well as the basis for legislation as the actual width of the tread, which, as has been said, can be had only with great annoyance and trouble, and not accurately even then.

7. *Discriminatory Taxation.*—While it may be admitted that a state can make rules and regulations seeking to prevent damage to the highways by excessive or unreasonable motor truck traffic, in some instances states have sought to add a taxation feature whereby trucks shall be taxed for the purpose of contributing to the upkeep of the roads. The logical method of attacking such legislation is by proving that it is discriminatory. Waiving the question as to whether or not the state has the right to tax special interests for the upkeep of the roads which are a public utility, it is possible to prevent the state from confining such taxation to one interest even though that interest may be responsible for nine-tenths of the wear and tear of the road. Not only do trucks use the roads, but so also do horses and wagons, automobiles and bicycles, and each kind of traffic wears out the road. Most state legislatures provide in their constitutions that all taxation shall be fair and equitable. The business man can invoke this provision in the constitution of his local state, and can thus by legal means prevent the operation of any such discriminatory taxation. If the state thereupon attempts to tax horses and wagons and all forms of traffic, it will encounter so many practical difficulties, not to mention the increased opposition, that its whole program is liable to fail.

8. *Wear and Tear an Impossible Basis for Taxation.*—Closely allied to the matter of discrimination, is the question of taxing motor trucks according to their damage to the road. Such a program, of course, approaches more the basis of fairness inasmuch as, if it were possible to determine the actual wear and tear caused by the trucks on a road, there might be some justification in apportioning taxation accordingly. Such a program was attempted in New York State and it ran up against unheard-of practical difficulties. The Motor Truck Club of America prepared a brief which fairly bristled with objections against any such program of legislation.

It was not hard to prove that not only was it a difficult thing to ascertain the effect of any given truck upon the road, but that it was practically impossible to determine the effect of various trucks of various kinds. Thus it was pointed out that trucks employing a four-wheel drive must necessarily have a different effect on road surfaces than those using the rear-wheel drive, that again electric trucks have an entirely different effect from gasoline trucks. Moreover, that worm drive trucks presumably differ from chain drive, and again trucks having pneumatic

tires differ from trucks having solid tires in the wear and tear which they produce on the street. The rate of speed is also a factor which has to be taken into consideration, the amount of unsprung weight, the character and resilience of the springs, and so forth. In fact, any number of variables were cited, not to mention the many different kinds and types of roads, all of which have their specific part in the problem and each one of which must be correctly estimated in the case of each truck before the answer can be given as to its precise part in wearing out the highways. Another very important variable, of course, was the amount of travel done by each truck on the state highways, which, of course, had to be ascertained in the case of each truck in order to determine its share in the total amount of road destruction.

It is, of course, impossible to assign to every vehicle, with scientific accuracy, its responsiblity for the wear of the roads. Nevertheless, some states have attempted to do this very thing, and when a legislature starts out to tax trucks according to the damage they inflict on the roads, the logical and most effective way of attacking such legislation is to prove its utter impossibility. This can be done by developing the points suggested.

9. *Unlawful Delegation of Legislative Authority.*—Some of the most troublesome cases arise when local officials take it upon themselves to draw up rules and regulations governing the use of the highways by trucks. Thus the state legislature itself is sometimes to blame for this, for cases have come up where the legislature has given power to highway officials to enact such laws as they may see fit regulating motor truck traffic. This is clearly an unlawful delegation of legislative authority, however, for, whereas a legislature is empowered to make laws it cannot make a law giving authority to *another body* to make laws. When the truck operator encounters a case of this kind, he should bring the matter before the courts by making a test case.

10. *Roads Constitute a Public Utility.*—The proper conception of roads is that they constitute a public utility, which it is the duty of the state as a whole, and not any special interest, to maintain. Not only are the highways free for use by everybody, but the benefits derived from their use accrue to everybody. This is true even with roads which are seemingly used to excess by special interests.

The cost of transportation is one of the big items in the high cost of living. It has been estimated that it costs more to move

goods from the country to the city than it does to transport them across the ocean. It should be obvious that if a farmer, for instance, by means of the motor truck is able to bring his goods into the district which previously was served by a more costly means of transporation, not only does the farmer derive benefits in increased business, but every person of the community profits by the decreased cost of the goods thus transported. It would be absurd to single out the motor truck user as the sole beneficiary from the use of the road.

In the same manner, it would be fully as impracticable to tax only those persons for the support of the public school whose children attend the school, or in a like manner, to tax only those ship owners whose ships use certain rivers and harbors, for the upkeep of those facilities.

11. *Organize for Influence.*—While the ten arguments sketched above may all be used effectively in combating unfair and unreasonable legislation, the truck owner should recognize that it is necessary for him to combine his influence with that of as many other truck owners as can be got together in order to secure a proper recognition of his rights. This can be done by forming motor truck associations, as is fully explained in the preceding chapter.

CHAPTER XXXII

PROBLEMS OF THE FUTURE

WHEN we consider the vital changes in our business methods and standards wrought by the motor truck in the brief period of its existence, it is not strange that, in readjusting conditions so as to make the most effective use of this new tool, we find ourselves confronted with many complex and baffling problems. Without attempting to suggest their solution, it may be interesting to group them roughly into three classes and indicate some of the more important aspects of each.

Let us first look at the problems of the truck and parts manufacturers, which are, of course, fundamental, and cannot be separated from those of truck users.

The Problem of Redesigning the Truck. The question of truck design will probably never be "finally" answered, so long as truck manufacturers continue their search for improvements—and in most truck factories the engineering departments are busy with experiments of all kinds. One of their main objects is to secure greater strength of all truck parts, while at the same time reducing their total weight. Wonderful progress is being made through the study and application of heat treatment to steel, and the development of new compositions for metals, by means of alloys. The great increase in the use of trailers has brought with it the problem of redesigning trucks to provide the most suitable factor of safety in view of the added strains imposed, while gear ratios are also being studied to develop greater power and facility for this purpose.

Truck manufacturers, realizing the vital relation between truck vibration and cost of upkeep are constantly studying the problem of design with reference to lessening the destructive effect of shocks and jars on the mechanism. The United States patent office is filled with concrete evidence of the widespread attention paid to this subject. All sorts of shock absorbers have

been designed and patented, ranging from improvements in spring construction, through the cushion wheel and down to the airless and punctureless tire. Some of these devices are fearfully and wonderfully made, and if they actually performed the miracles claimed for them, truck mortality would be eliminated.

One comparatively recent development bids fair to become a permanent factor, however, if it can be perfected without too great initial expense, and that is the magnetic drive type of transmission. This system, already familiar to passenger car operators, eliminates almost entirely the terrific strain developed in throwing gears into engagement, with its consequent wear and tear on all moving parts. The chief difficulty up to this time, however, has been to deliver the necessary horse-power to the rear wheels when traveling at low speed. With the enormous increase in the consumption of gasoline and its constantly rising cost, some truck engineers are studying the problem of developing more driving power per gallon, while others are perfecting engines designed to use less expensive fuels.

Wanted: "A Truck with Horse Sense." A substantial reward awaits the manufacturer who succeeds in developing a truck with "horse sense" for house-to-house deliveries, of which the milkman's cart is typical. For this particular service Dobbin's faithful intelligence is unsurpassed. Even with no guiding hand on the reins, he knows when to "giddap" and when to "whoa"; when to steer a straight course, and when to turn a corner. Perhaps some genius will sooner or later find a solution, but as yet the problem remains unsolved.

Turning from the field of design to that of production, the questions involved are so closely allied to methods of factory management that it would be impracticable to discuss them here in detail. In passing, however, it may be said that there seems to be a well-defined movement toward the use of so-called "standardized parts," due to economies in manufacture, speed in production, and what is particularly desirable today, more numerous sources of supply. Many of the new army trucks purchased by our government are made up entirely of standardized parts, and the entire industry is watching with keen interest the example of the "Liberty truck" in this respect. (Figure 308.)

Problems of Sales Distribution. In regard to the problems of distribution and sale, truck manufacturers have very largely given up the early methods which prevailed when the industry

was indistinguishable from "the pleasure car game." The majority of truck agencies are no longer found on the "Automobile row," where rents are high and the advertising value of space is unnecessary. The frills are being put aside for more substantial factors, and the industry is now being conducted more nearly as it should be, on the basis of manufacturing a piece of machinery of high efficiency and relatively low cost.

With the growing market for the sale of trucks to farmers, however, a new problem arises, viz., to provide sales and particularly service facilities for trucks in the smaller towns. The time has passed when truck manufacturers may safely appoint as an agent or distributor a villager who desires to buy a truck for himself and who has been shrewd enough to ask for the agency in order to secure the agent's price, with no thought of accepting the responsibilities of such a connection.

Perhaps the greatest problem connected with the sale of trucks, however, is to show the user that improved operating conditions will amply repay all the time and money spent to bring them about. Manufacturers must provide some means for more frequent and more intelligent inspection and maintenance of trucks after they are sold. It is becoming ever more apparent that daily expert inspection of trucks in service will be the means of preventing many abuses which in most cases are not corrected until the truck is actually put out of commission; and, even after it is repaired, the real cause of the difficulty may not have been corrected.

Better Cost Records Essential. In the second group of future problems let us consider those confronting truck users as individual owners, and as clubs or associations of owners. With expenses mounting on every hand, with the difficulty of getting careful drivers, what can the truck owner do in the future to make his motor truck delivery a greater aid to business profits? In the first place, he should begin at once to keep an accurate record of his costs, as that is the only means by which he can tell whether his equipment is costing him too much or saving him as much as it should. From the various cost systems previously described, the operator should be able to secure one that will serve his purpose, and, use it faithfully.

Several schemes have been proposed by which individual operators in the same kind of business, or in kindred lines, may, without disclosing their identity, by making use of a standard

FIGURE 308: The Liberty truck—made of standard parts to standard specifications for the United States Army, has recently made its appearance. Several manufacturers have received orders to manufacture this truck.

FIGURE 309: We are just beginning to realize what women can do in vocations formerly monopolized by men. Women truck drivers are already here. With the aid of auxiliary devices they perform duties hitherto considered impossible.

FIGURE 310: Yes, she is a freight handler, but the modern electric industrial truck, with its simple and perfect control, enables her to remain her feminine self while moving tons of freight about the warehouse.

FIGURE 311: Keeping trucks busy enables their owners to make the best of labor shortages. It takes time to load lumber, but here a trailer and not a truck is being held up. When the truck returns it finds its load waiting for it.

cost system, compare their own operating costs with an average of many others, thus learning to what items they should turn their attention in order to improve their service. The greatest difficulty with such a scheme, however, is to establish comparisons based on conditions which are reasonably similar. The Truck Owners' Conference, Incorporated, of Chicago, has devised a method through conferences of truck owners, by which this is being done on a scientific basis, without disclosing facts of a confidential nature. No effort is apparently being made to commercialize the system through membership fees, bureaus, or other methods, and the standard forms will be distributed to users at cost from different sources. (See Insert I.)

Community Garages. In view of the advantages to be gained through proper inspection and maintenance, which are found to a remarkable extent in the largest and best-equipped private garages, where fleets of trucks are cared for, and because of the difficulty of securing such care on the part of the owners of small numbers of trucks, it is not surprising to find groups of individual owners getting together and establishing "community garages." Their object is to give such owners the advantage of proper care with respect to the ordinary storage and cleaning of their vehicles; to supply gasoline or electric driving current; to provide inspection and maintenance of their machines, and to rent spare trucks of similar capacity when their own are being overhauled. This development, if properly organized and supervised, bids fair to solve for many truck owners one of the most difficult problems of the future.

How to utilize trucks standing idle or running empty, providing the latter with "back loads," is a problem recently attacked by truck owners in the state of Connecticut. The scheme calls for the establishment of agencies to act as connecting links between shippers and truck owners, so that the latter may be directed from time to time to places where freight is waiting for trucks. The congestion of the railways and the consequent use of trucks for long-distance hauling was the immediate cause of this effort. For example, trucks carrying freight from New Britain to Hartford might return with no loads, unless they knew where return cargoes were to be found. The state commissioner of transportation is giving his services to the owners of the 12,000 motor trucks in his state to solve this problem, and it is understood good progress is being made.

Where Will the Drivers Come From? The shortage of drivers due to war conditions has served to focus the attention of truck owners on this serious difficulty. It is not unusual for one or more trucks to be out of service for days at a time because drivers cannot be found to man them. This problem has given rise to several attempts toward solution. One large eastern concern, following the example of English truck owners, has introduced women drivers and helpers. (Figures 309 and 310.) Cooperative delivery systems have been resorted to, with indifferent success, the difficulties being to adjust the routes and time schedules satisfactorily to all concerned. Perhaps the most common method of attacking the problem has been to employ older men, as chauffeurs, and to use auxiliary devices so far as possible, particularly demountable bodies and trailers, which can be loaded and unloaded by unskilled labor, thus permitting the driver more time to run his truck. (Figure 311.)

Many of the difficulties which beset the owner of a smaller number of trucks are intensified for the large fleet owner, although with a proper system of inspection and maintenance, and a sufficient supply of extra trucks and parts, he is spared some of the annoying delays due to repairs and renewals.

The Future of Truck Associations. Turning now to the future of motor truck associations, it may be said that, in view of their small number and the comparatively short period of their existence, their problems lie entirely in the future. Without doubt, such clubs constitute a very important and tangible source of strength to individual owners, and they should be faithfully supported wherever they exist. New clubs should be formed and their activities fostered by all who wish to secure the best conditions possible for truck operation.

One association in a large city has done much toward relieving traffic congestion through the crowded districts by suggesting and securing the passage of city ordinances respecting the use of certain streets by trucks only, one-way traffic, and so forth. They are now considering the advocacy of moving certain kinds of freight at night only, giving trucks so used special privileges as to speed and right of way, which would not be practicable during the day time.

The Crying Need for Better Roads. By far the largest, most difficult, and most important problem facing truck owners today, however, whether as individual operators or as associa-

FIGURE 312: A road or a barrier—which? Well may the truck pause, and decline to furnish transportation to the community beyond. A half-mile stretch of mud like this may separate two cities as effectually as a deep river.

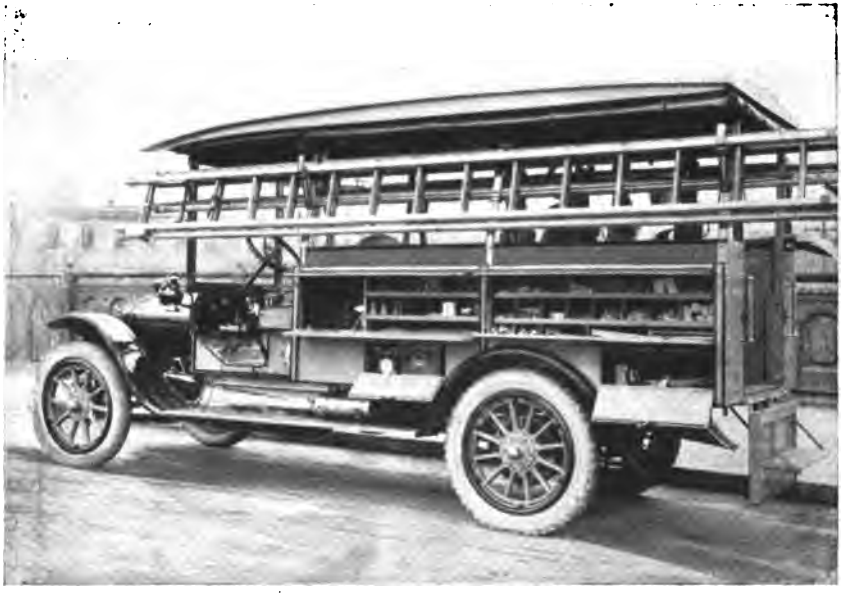


FIGURE 313: Telegraph and telephone companies were among the first to recognize the value of motor trucks in their business. This car is a "trouble shooter" complete to the very last detail. As a matter of fact, it is a machine shop on wheels.

FIGURE 314: Transportation is a big item in the cost of fruit and vegetables. The truck cuts down that item, and enables the owner to deliver them while fresh and extends the field of operation far beyond that which horses could cover.

FIGURE 315: In the old days the farmer used to start for town at 2 in the morning, with a lantern on the wagon seat. Today 5 or 6 a. m. is early enough if he is the modern type of farmer who has learned the value of a motor truck.

FIGURE 316: Not only have motor trucks changed the big business problems of the large cities, but their influence upon the great problem of successful farming is rapidly increasing. Markets once far away are today close at hand.

FIGURE 317: This monster which drags 12 plows through tough sod is kith and kin of the motor truck, and demonstrates how by sacrificing speed, it is possible to increase pull almost indefinitely. Tractors mean a revolution in agricultural pursuits.

FIGURE 318: This tractor burns kerosene, and draws two plows behind it. It gets the necessary power by means of gear reductions. One company plans to manufacture several hundred thousands of these tractors each year.

FIGURE 319: An intruder in the rural landscape, but it helps the farmer make money by carrying more goods, and carrying them faster. Distant markets become close at hand, and one truck equals four or five wagons hauled by Dobbin.

tions, is the need for securing better roads for motor transportation, both for city and interurban deliveries. (Figure 312.) The good roads movement has such a vital appeal to all business men in city and country that the task is not so much one of arousing public interest as it is of securing adequate federal and state appropriations, and especially of establishing efficient administration in building and maintaining public roads. This problem calls for a high order of construction engineering and eternal vigilance to prevent fraud and second-rate work. Every motor truck association should have its good roads committee which should be active in securing information from all available sources, whether city, state, or national. In this connection much praise is due the American Highway Association, whose headquarters are in Washington, D. C., for its intelligent and progressive work in developing public interest in this movement. The year books published annually under its direction are particularly valuable as a means of giving widespread distribution to important information on all phases of highway construction and maintenance.

Why Trucks Should Replace Draft Horses. The third and last group of problems awaiting solution in the future is concerned, not with truck owners, but with the public served by motor trucks. It may safely be assumed that, whether they are conscious of it or not, people as a whole would be better off if the horse were eliminated as a draft animal. For centuries he has served us faithfully and well; in fact, considering the important part he has played in the development of human welfare, he has deserved better treatment from his master than he has usually received. By comparison with motor transportation, however, it must be admitted his standards of performance are not meeting public needs in three important respects. First, he lacks speed, power and endurance. Next, the food he consumes is too valuable, and the work required to produce it should be devoted to human needs. And finally the unsanitary conditions surrounding his daily life are a menace to public welfare. Hence, we are witnessing that remarkable event in the world's history—the passing of man's long and faithful friend, the horse, and his replacement by the powerful, tireless, economical, and sanitary motor truck.

The problem before the public is, how can we make this new system of transportation serve us universally with as little delay

as possible? How can we obtain this improved motor service as applied to the food we raise on our farms and in our gardens, the goods we produce in our factories, and, for that matter, for ourselves as passengers in going about our daily business?

So far as the movement of food is concerned, a new business has lately sprung into existence, which will help to meet that particular need on the part of the public. Enterprising hucksters (Figure 314) are buying fast, light trucks and, by getting started early in the morning, are actually calling at the farms within a radius of 30 to 50 miles for fresh fruit and vegetables, for which they are finding a ready market among the dwellers in the cities, whose demands at hotels and restaurants are satisfied with nothing but the best. (Figure 315.) In many cities the hotels themselves operate farms whose fresh produce their trucks call for and deliver daily. In fact, certain hotels feature such equipment in their advertising.

Farmers, who have been quick to avail themselves of the use of passenger cars, and who have learned how to run the gasoline engine, are turning now to the motor truck (Figure 316), to keep pace with the increased output of their farms, made possible by the application of scientific principles of management. New and better methods of fertilization and cultivation, in which the motor tractor is playing an important part, are yielding abundant returns. (Figures 317 and 318.) Moreover, as the shortage of horses, due to the demands of the war, has compelled our farmers to seek a substitute, they are today buying motor trucks faster than the industry can supply them. (Figures 319, 320, 321.)

Trucks on the Farm. In passing, it may be interesting to note one of the reasons given by an Indiana farmer for not only buying a truck himself, but for taking the agency for the one he did buy. (Figure 322.)

"You see," he said, "I live down in the hog country, about ten miles from the nearest market and freight station. Well, when I sell hogs, I git so much a pound for 'em, live weight, an' it's quite a trip for my hogs when they run from my place to the station. An' even if I feed 'em up good before I start 'em, an' give 'em plenty o' water, there's a good bit o' shrinkage before they git to market. So I fig'red if I could save the shrinkage I'd git a good bit more for my hogs.

"Well, I looked around, and decided to buy an automobile truck so's I could *ride* my hogs to market. You prob'ly won't believe it, but I pret' near made enough out o' the weight o' the first five batches o' hogs that rode to the city to pay the first installment on the machine! Now I'm sellin' trucks to all the farmers in my part o' the state, an' they're buyin' 'em, too."

FIGURE 320: When cattle ride on rubber tires there must be a reason for it and here it is. Hauling cattle by motor truck costs so much per mile, but walking them costs so much per pound. It is obvious which method is the more profitable.

FIGURE 321: This arrangement is simple, but effective. The farmer's little car is not fitted to carry his produce, but it can easily haul it. A two-wheeled gig, easily attached, offers farmers the advantage of "motor truck delivery."

FIGURE 322: The motorbus is doing effective work in dozens of cities. But present accomplishment is as nothing in comparison with future possibilities, if we may judge by the enormous expansion of motorbus service abroad.

FIGURE 323: Farmers sell hogs and cattle by the pound, live weight. To prevent loss due to "shrinkage," in driving them to market, producers are now using light, speedy motor trucks capable of carrying twenty to thirty animals.

FIGURE 324: See the camouflage of straw, but don't let it hide the fact that this train of London omnibuses is carrying a battalion to the front. Good highways were never so important from a military point of view as they are today.

FIGURE 325: This is a type of truck often used in constructing highways. Its driving power is delivered to all four wheels and enables it to negotiate difficult roads and haul wagons or trailers filled with equipment or road-building material.

FIGURE 326: The military significance of good roads can scarcely be exaggerated. It is not too much to say that France was saved by motor trucks operating over good roads. In this country, military motor highways are a prime necessity.

FIGURE 327: On a good road, trucks can transport troops almost as fast as railroads, and thousands may travel over a single highway. Railway traffic is limited, but there is almost no limit to the trucks that can travel a good highway.

Another development to which the public should lend substantial encouragement in the future is that of rural free delivery by Parcel Post trucks. There is practically no limit to the amount and kinds of dairy and garden products which may be successfully sent to city markets and even to individual city patrons by this method. To this end, in fact, it has been decided by Congress to turn over to the Post Office Department any army trucks which may be left after the war, not needed for military purposes.

What Standard Freight Package Would Accomplish. Although we have considered many specific methods by which truck owners may improve their service to themselves and their customers, there is one problem concerning the transportation of certain kinds of freight, in whose solution the public as a whole should take a keen interest. Let us suppose that goods are to be shipped from Chicago to New York. If they are packed in substantial crates or boxes, which may be placed upon a truck with a stake body, at the shippers' door and sent by rail on flat cars directly to the consignee, the latter may send to the receiving terminal a truck having a chassis designed to take the shipping crate, using, if necessary, special lifting devices to save time and difficulty in handling. Suppose the sizes of such intercity freight packages should become standardized for all cities in the United States, and the railroads should supply the necessary motor transportation facilities at all terminals! The system would surpass in directness and flexibility the present method of shipping freight to all points in box cars. This idea is now being given careful study with a view to establishing the necessary terminal facilities, and in time it should prove to be one of the greatest economical advances in the transportation of our merchandise. It is also receiving the attention of the federal government.

What May be Expected of the Motorbus. The development of passenger transportation by motorbus, now in its infancy in this country, is destined to become one of the notable improvements over our present methods. (Figure 322.) We now have but few well-established bus lines giving remarkably regular and high-class service, such as the Fifth Avenue Coach Company in New York and the Motor Bus Company in Chicago. By comparison with similar service in hundreds of European cities, however, we have far to go in perfection of detail, flexibility of route and low bus fare.

The advantages of such lines over the ordinary street car service are so numerous and so apparent that they need only the briefest mention, for the sake of emphasizing their relation to improved motor truck service. In the first place, it must be remembered that the best buses today are far more satisfactory in point of speed, comfort, and reliability than their early predecessors. The running schedules of the Fifth Avenue coaches, for example, are almost if not quite as dependable as any street car service. (Figure 185.) Next, by drawing up to the curb to take on and discharge passengers, they make it unnecessary for trucks or passenger cars to stop, as they now must when they are following a street car.

Again, in case a fire or some unusual accident prevents street cars from running over their regular routes, they are obliged to stop, thus tying up traffic in both directions, and causing serious congestion as a result of the long line of cars blocked by the fire. The motorbus, on the contrary, is not delayed, but merely seeks the nearest route around the scene of trouble, thus neither delaying the passengers particularly nor causing undue obstruction to motor trucks and other traffic.

Street pavements need not be disturbed to lay tracks for the motorbus, nor do they require dangerous and unsightly overhead trolleys. Routes may be established on short notice to accommodate the shifting centers of population, and by reason of their quiet operation there is less objection to having them travel through residential sections.

The Electric Taxi. While taxicab service, as a business, is somewhat like that of the motorbus, it is so closely akin to the ordinary passenger car that we have not considered it within the scope of the present volume. In passing, however, it may not be amiss to suggest the wonderful possibilities awaiting the establishment in the larger cities of electric vehicle taxicab lines. It should be understood that such service requires a specially built car to give the most satisfactory results, but the quick acceleration, high speed, silence, cleanliness, and freedom from unpleasant odors, all of which are available in the best type of electric vehicle, place it in a class by itself, high above all other types of cars for taxicab use. In addition to these advantages, it has unusual sturdiness and durability combined with low cost of operation and maintenance, which makes it particularly desirable from the point of view of business profits.

FIGURE 328: This is a type of electric taxicab which has great possibilities. Quick on the "getaway," at home in city traffic, silent, odorless, and fast, it has the sturdiness that comes from simplicity and a small number of moving parts.

FIGURE 329: What motor trucks mean to the express companies is only hinted by this fleet. It is about 1% of the entire number operated by the American Express Company. Other express companies also use many motor trucks.

FIGURE 330: Motor trucks not only play an important part in building roads, but they are also used to keep them clean and in repair. Speed gives them a great advantage over horses while their engines control the pressure in the flushing tanks.

FIGURE 331: Motor trucks are playing an increasingly important part in the employment of inland water routes to supplement railway freight transportation. The Department of Commerce in Washington is studying this problem.

FIGURE 332: This bit of scenery was "snapped" at the approach to the western terminal of the Lincoln Highway, which constitutes the most direct motor route between New York and San Francisco. It is is 3,284 miles in length.

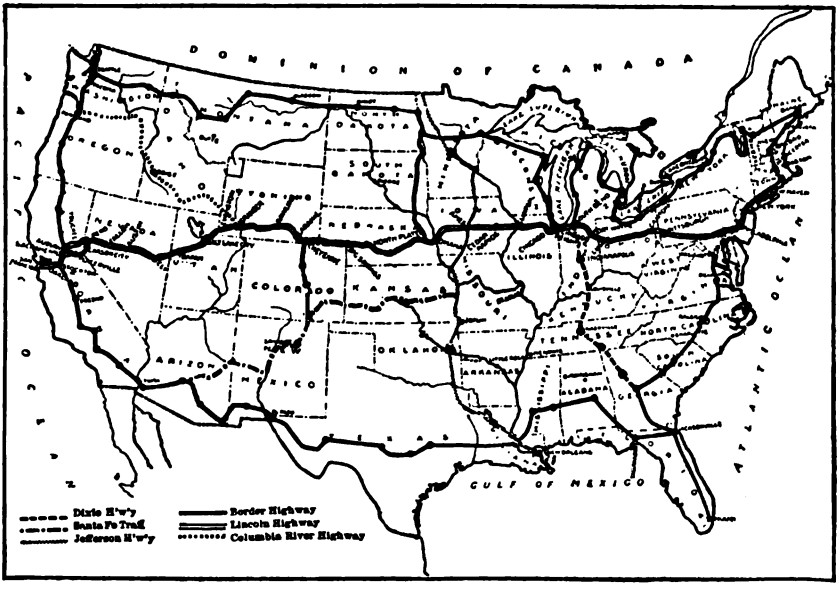


FIGURE 333: From East to West and from North to South great, broad highways are being constantly planned and built across our country. Arteries of commerce in time of peace, they will be of great military value in time of war.

FIGURE 334: More than one truck is doing duty as a locomotive. Steel wheels with flanges and a drawbar attachment seem to be the only changes necessary. If a 5-ton truck today can haul six loaded cars, what of the future?

FIGURE 335: One truck engineer has devised a flanged wheel, which is demountable and can be readily bolted in sections to an ordinary truck wheel. This development opens big possibilities concerning its use on railroads.

A notable installation of such taxi service is that of the Detroit Taxicab and Transfer Company, one of whose de luxe cars is shown in Figure 328. In outward appearance it resembles a high grade private town car, and only those who have experienced the satisfaction of riding in one can appreciate its unique fitness for taxicab service. When the advantages of this type of electric taxicab become more generally known, the demand for them is very likely to be so great that ordinary gasoline taxis will not be able to compete with them.

What Trucks May Do to Win the War. Finally, in our consideration of the future in relation to the public served by motor trucks, the Great War has brought home to every thoughtful American the immediate need for an improved system of national defense. More or less against our will, we have been made to realize that, as a nation, we are no longer secure from the aggressive designs of foreign nations, and that our comfortable repose in the peaceful traditions of a century must be ended. If we are to maintain our liberty and independence we must readjust our national policies to correspond with our new vision of the policies of other world powers.

It would be quite beyond the scope of this volume to discuss the various ways in which the motor truck may best be made to serve in this readjustment. The war has taught us, however, that nations fight not only with armies, navies, and aircraft, and their accompanying requirements of guns and ammunition, but also with every available resource of commerce and industry. In order to meet the nation's requirements, we have seen our factories speeded up so that their output far exceeds that of normal times. We have increased the yield from our agricultural areas far beyond their usual output. But in doing those things we have placed an enormous burden on the carrying capacity of our railroads, so that, nowithstanding the great increase in tonnage hauled, they are unable to meet the national requirements. This is partly due to the shortage of locomotives and cars, and partly to the congested condition of the freight terminals. While the latter is being relieved somewhat by the addition of ships to our merchant marine, much freight not destined for ocean shipment is held up at railroad terminals because of inadequate facilities for handling the enormously increased tonnage. This problem is assuming tremendous proportions and must be solved to prevent disaster.

In relieving this situation, the motor truck is playing an increasingly important part. It is fast becoming a rival of the railroad in the transportation of freight for relatively short hauls where highways are suitable, and for this service it possesses the notable advantage of door-to-door deliveries, thus avoiding and helping to lessen terminal congestion.

By operating the terminals independently, night and day, either under private control or contract with the railroads, or perhaps under government supervision, which would of course necessitate the cooperation of shippers and receivers of freight at the principal railroad terminal points, the tireless motor truck, with a sufficient number of shifts of men, would make it possible to keep this highly important process in operation practically without stopping. Purely as a military measure, the government could delegate the execution of this task to such organizations as the express companies, whose fleets of trucks (Figure 329), augmented by privately owned trucks, rented for this emergency, could go far toward solving the terminal problem.

How Motor Trucks Helped Defend Verdun. But the motor truck will never be able to contribute its share toward national defense until adequate military highways have been provided. The Great War offers notable examples of the part played by military highways in both offensive and defensive campaigns. (Figures 189 and 324.) Perhaps the most conspicuous case of the latter has been the defense of Verdun. In describing the way in which General Pétain depended on the use of the highways by motor trucks at this vital point, Mr. Frank H. Simonds, the noted war critic says:

"Save for a crazy, narrow-gage line wandering along the hill slopes, climbing by impossible grades, Verdun is without rail communication. It was this that made the defense of this fort next to impossible. Partially to remedy this defect the French had constructed a local highway running from St. Dizier by Bar-le-Duc to Verdun beyond the reach of German artillery. Today an army of a quarter of a million men, the enormous parks of heavy artillery and field guns—everything is supplied by this one road and by motor transport. The road was as wide as Fifth Avenue, as smooth as asphalt—a road that, when peace comes, if it ever does, will delight the motorist. Despite the traffic it had to bear, it was in perfect repair, and soldiers in uniform sat by the side breaking stones and preparing metal to keep it so."

Attempts have been made in the past to focus attention on this vital need of our country, but nothing could have demonstrated to us the advantages of adequate military highways so

convincingly as the part they have played in the belligerent countries. We may, therefore, predict with confidence that the United States, as a whole, will demand and support as a national policy, the construction of both transcontinental and coastwise motor truck highways suitable for national defense in time of war, but which, in normal times, will be used as vast arteries of commerce. (Figure 333.)

Motor Trucks and Water Routes. Another development which is urged as a measure of national defense, in order to relieve the congestion of the railways, is the use of existing waterways and the building of new ones for freight transportation. There is no doubt that much non-perishable freight might be moved by boat on rivers, lakes, and canals more cheaply and quite as suitably as by rail. The national policy of Germany in this respect for the past forty years affords a striking example of what may be done to keep down the cost of transportation, through the development of inland waterways, both on account of the low cost of water transportation and the competition it develops with the railways for this business. If this, too, is developed in the United States, as a national policy, motor trucks will play an important part at shipping and receiving points (Figure 331), since they can cover effectively an area of tributary territory having a radius of fifty to seventy-five miles, provided they have fairly good roads and average weather conditions.

Finally, the enormous increase in our export business as a result of this war has brought home to thoughtful Americans the fact that we are at the dawn of a new era in respect to the development of our foreign trade. We are slowly beginning to realize that, instead of continuing to be the world's storehouse, for commodities of all kinds coming from the soil, such as cotton, wheat, corn, lumber, coal, minerals, oil, and other products which we have exported in the crude or semi-crude state, we shall have the opportunity, through the development of American manufactures and a suitable merchant marine to sell abroad not only our natural resources, but the fruit of American labor as well. In order to avail the nation of these opportunities, however, we must foster and develop good roads from farm to station; better railroad and terminal facilities, with state handicaps displaced by federal regulation; new and more varied seaports on different parts of our coast; new trade treaties to protect our interests and adjust them to new international relationships.

In short, American business men must be educated to the need of taking a broad, cosmopolitan view of world politics and world affairs, in which the United States shall perform her duty to herself and to the world, thereby winning the friendship and respect of all nations. To this end the motor truck, well made, honestly sold, and intelligently handled, will play a part of constantly increasing importance.

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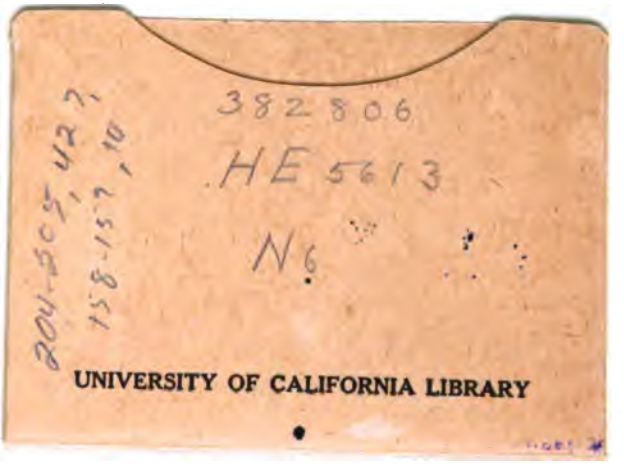
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